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Swedish Electricity Market 1998

Swedish National Energy Administration

Foreword

The organization of the Swedish electricity market has been in a state of continual change since the electricity market reform work was begun in the early 1990s.

The new Electricity Act has changed the institutional framework and has created new conditions for the development on the electricity market. The purpose of the reform is to introduce greater competition on the electricity market and increase the freedom of choice for consumers, and to create conditions necessary for efficient pricing by open and expanded trade in electricity.

Since 1 January 1998 the Swedish National Energy Administration has been responsible for supervising the new electricity market. One of the tasks entrusted by the Government to the Energy Administration was to follow developments on the Swedish electricity market and to regularly compile and report current market information.

The purpose of the publication entitled "Swedish electricity market in 1998" is to provide the players on the electricity market - the decision makers, the media and the general public - with generalized and readily accessible information on market conditions. The publication includes summaries of information from recent years concerning electricity generation and utilization, structure of the electricity market from the players' perspective, trade in electricity in Sweden and in Northern Europe, electricity prices in Sweden and other countries, and the impact of the electricity sector on the environment. ■

Eskilstuna, July 1999

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The advent of electricity in Sweden dates back to 1876. Steam engines were then used for generating electricity. The first commercial application of electricity was for arc lamps that were used for providing working lights in sawmills. Electricity based on hydro power was first generated in 1882 at Viskan in Västergötland County.

Electrification in Sweden

At the beginning of the 20th century, the question of how Sweden was to be electrified was the most important propelling force for developments on the electricity market. Developments were governed by the demand for electricity and by technical progress. In the initial stages, the major cities had to be supplied with electricity for lighting, but electric power soon began making large-scale inroads into dwellings, the services and industry. By the early 1920s, electric power was already available to large parts of the country. At the end of the Second World War in 1945, the annual electricity consumption amounted to 11.5 TWh.

By the 1930s, the largest hydro power resources in central and southern Sweden had already been developed, and the expansion of hydro power continued mainly in northern Sweden. This also gave rise to the need for transmitting electric power to major consumer areas in the south. The first 220 kV line was built in 1936. In 1946, the decision was taken that Vattenfall be entrusted with responsibility for all new lines in the national grid. Thus the role Vattenfall would play for many decades ahead as Sweden's largest power generation utility, with responsibility for coordinating the supply of electricity to the whole of the country, was established. In 1992, Vattenfall was reorganized into a limited liability company, and responsibility for the national grid was then transferred to the Government-owned utility known as Svenska Kraftnät, the Swedish national grid.

A growing economy needs electricity

Sweden's national economy grew briskly after the Second World War, and the need for energy and electricity grew correspondingly. Construction of coal-fired and oil-fired thermal power stations began when hydro power capacity no longer sufficed. A decision was announced at the end of the 1960s that the four large undeveloped rivers in northern Sweden would be protected, which put a practical stop to further major expansion of hydro power. In the early 1970s, hydro power accounted for 70% of the total electricity generated, and oil for just over 20%.

From oil to nuclear power

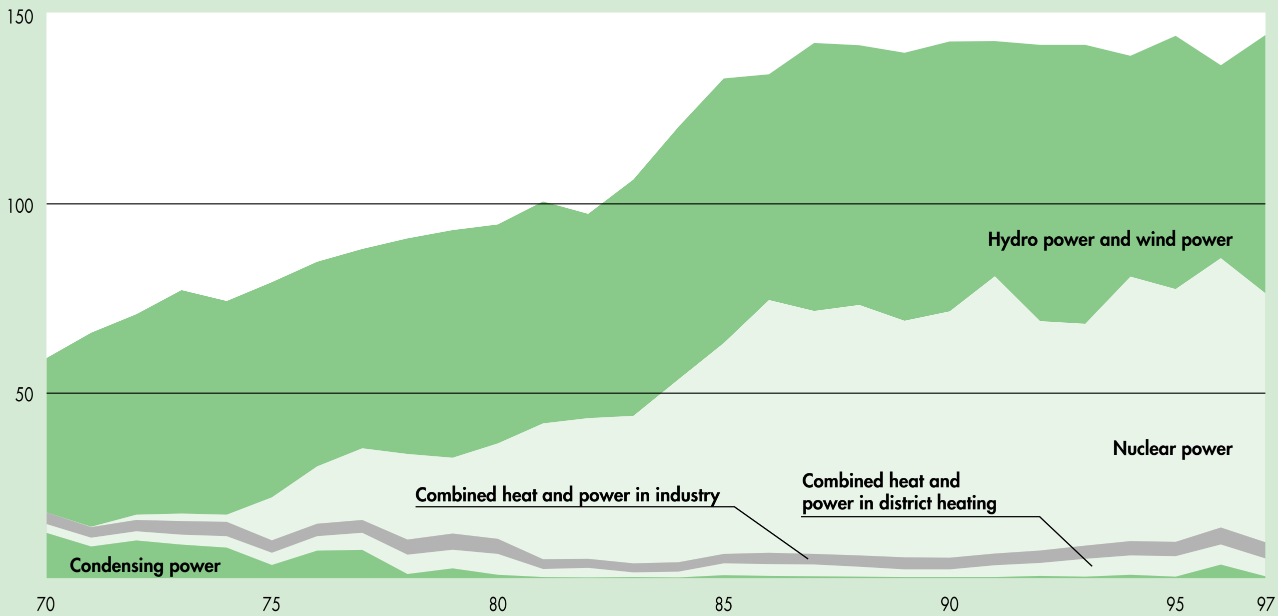
In 1970, Sweden's oil dependence amounted to more than 75% of the total energy supply. As a result of the oil crises, much of the world, including Sweden, was faced with high oil prices. During the years that followed, Sweden's energy policy was therefore focused on reducing the importance of oil to the energy system, one of the results of which was a substantial increase in electricity consumption. A major investment programme for light water reactors was launched in the early 1970s, and the first reactor was taken into operation in 1972 in Oskarshamn. By the mid-1980s, when the last reactors were commissioned, nuclear power and hydro power accounted for a total of 95% of Sweden's electricity generation.

Following the accident at the Three Mile Island nuclear power plant, a nuclear power referendum was held in Sweden in 1980. The Riksdag, Swedish Parliament, then decided that the nuclear power units that were already in the course of construction would be taken into operation, but that no further expansion of nuclear power would take place, and that nuclear power would be phased out by the year 2010 at the latest.

The nuclear power issue again came to the fore after the Chernobyl accident in 1986, and the Riksdag decided in principle that decommissioning would begin by two reactors being taken out of service in the mid-1990s. Since the end of the 1980s, the energy policy was focused on creating the conditions necessary for changing over the energy system in Sweden.

An energy policy decision was taken in 1991, according to which the pace of decommissioning would depend on the results of electricity conservation measures, the supply of electricity from environmentally acceptable energy sources, and the scope available for maintaining internationally competitive electricity prices. A parliamentary commission - the Energy Commission - was appointed in the summer of 1994, and the results of its work were presented in December 1995. The Commission concluded that national economy and environmental considerations favoured

Figure 1 • Electricity generated in Sweden between 1970 and 1997, TWh



Source: *Energiläget 1998 (Energy in Sweden 1998)*, Swedish National Energy Administration.

the change-over of the energy system being carried out over a long period of time, in order to achieve the energy policy objectives set out in the 1991 decision. The Commission also considered that no decision should be taken concerning the year when the last reactor would be decommissioned. The Energy Commission found that the energy and environmental policy objectives were still in conflict.

The reformed electricity market

The new Electricity Act came into force on 1 January 1996. The objective of the reform is that free competition would improve efficiency on the market, and that improved efficiency would be of benefit to consumers.

The electricity networks throughout the country must be open to all players on the electricity market who have paid a connection charge somewhere in the country. All consumers have the right to choose freely the supplier of the electricity they use.

A prerequisite for effective competition is that network operations should be economically separated from trading in and generation of electricity. Network utilities can trade in electricity only for network operation purposes, e.g. for compensating for transmission losses, or for easing the effect of bottlenecks in the network.

Since the transmission of electricity is a so called natural monopoly, network operations must be regulated and monitored. The Swedish National Energy Administration is responsible for monitoring the network operations on the reformed electricity market. One general task is to create good conditions for effective competition. The Energy Administration grants permits for pursuing network operations, ensures that the network utilities follow the relevant laws, and ascertains that the network prices are reasonable. The scope available to consumers for assessing prices and price development is substantially improved, since the price of electricity and the price of the network service are specified separately.

Towards a sustainable energy system

The Riksdag decided on new energy policy guidelines in June 1997. The objective of the energy policy is to safeguard - in the short term and in the long term - the availability of electricity and energy from renewable energy sources on terms that are competitive in relation to the surrounding world. According to the decision, phasing out of nuclear power should also be started.

In December 1997, the Riksdag passed the Nuclear Power Decommissioning Act, and the Government decided in February 1998 that Barsebäck 1 would be decommissioned no later than by the end of June 1998. Moreover, Barsebäck 2 would be decommissioned by the year 2001, provided that the loss of generation capacity could be compensated by reduced electricity consumption and increased supply of electricity. No final date was set for the rest of nuclear power decommissioning. However, the Supreme Administrative Court decided in May 1998 that the implementation of the decision to shut down the Barsebäck 1 reactor in June 1998 would be shelved for the time being.

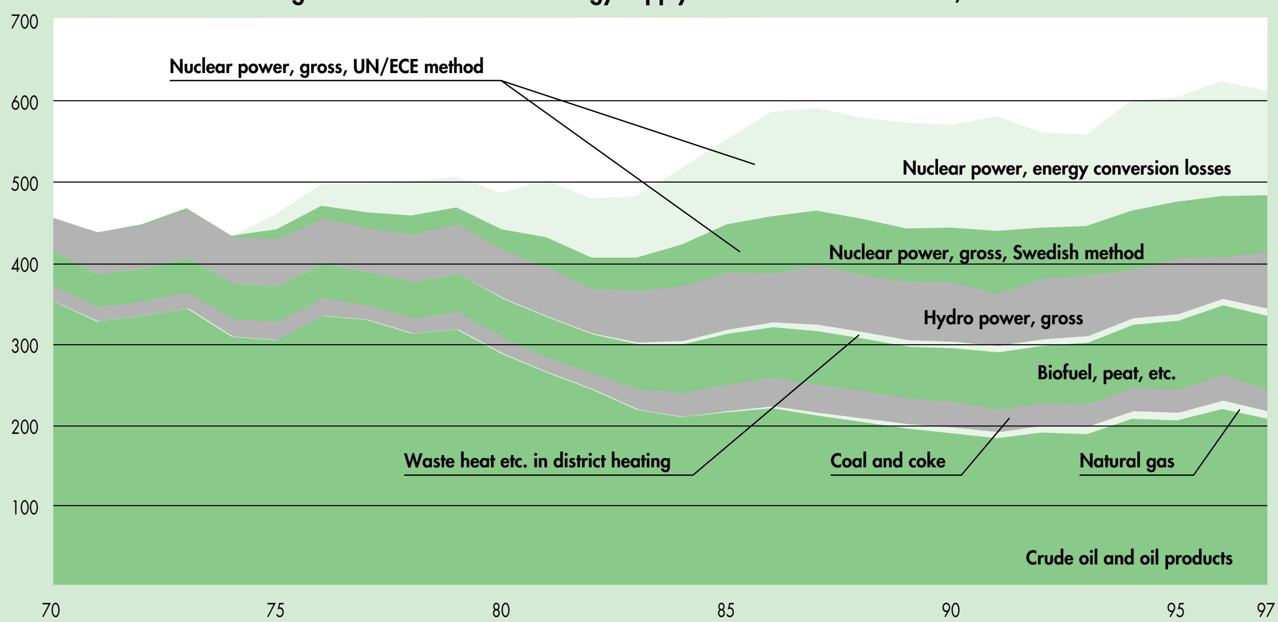
A comprehensive energy policy programme was started with the aim of facilitating the change-over in the supply and utilization of electricity and other forms of energy. The work of implementing most of the programme and coordinating the change-over work is led by the Swedish National Energy Administration which was set up on 1 January 1998. A total of SEK 9 billion is being assigned over a period of seven years, and SEK 1.1 billion of this total was made available during 1998.

Environment and climate

The energy policy is being guided to an increasing extent by environmental problems. Measures against the harmful effects, acidification and over-fertilization caused by combustion have been adopted long ago, and the work is continuing. Growing knowledge of the greenhouse effect caused by carbon dioxide emissions has resulted in intensive international work in the field of the climate, and in the drawing up of the Kyoto Protocol.

The Government appointed a Climate Committee in May 1998 and instructed it to submit proposals for a concerted Swedish strategy and a plan of action that would enable Sweden to meet its national and international climatic commitments. The Committee's results are due in December 1999. ■

Figure 2 • Sweden's total energy supply between 1970 and 1997, TWh



Source: *Energiläget 1998 (Energy in Sweden 1998)*, Swedish National Energy Administration.

1998 was the third year of the reformed electricity market in Sweden and also in Finland. The electricity market in Norway was deregulated back in 1991.

Structural changes

According to the new Electricity Act, a corporate body that generates and trades in electricity is banned from also engaging in the transmission of electricity. This corporate separation is aimed at setting a clear demarcation between competitive operations and monopoly operations, thus counteracting the occurrence of cross-subsidies, and also at facilitating electricity trading and network activities, so that these can be developed independently of one another in terms of structure and ownership.

During 1997, the electricity market was characterized by major structural changes in the ownership of major power utilities, and also of municipally owned electricity trading and network companies. These structural changes continued during 1998. Structural changes took place mainly in the field of electricity trading. Several municipal electricity trading utilities have merged into joint companies for the purchase and resale of electricity.

Ownership changes have also taken place across national borders. Several major power utilities in Norway, Germany, France and Finland have acquired holdings in Swedish utilities. Swedish companies have also taken over or purchased shares in power utilities abroad.

Keener Competition

1997 and 1998 were characterized by stiffening competition on the electricity market. New players, such as the OK, Statoil and Shell oil companies, have entered the market. Small companies have merged or have been taken over in order to form more competitive units.

With the aim of increasing competition and further broadening the freedom of choice for consumers, a study committee was set up in 1998 for the purpose of reviewing the system that demands hourly metering on changeover to a different electricity supplier. In December 1998, the Riksdag decided that requirements for hourly metering would be replaced on 1 November 1999 by a standardized settlement system for customers whose fuse rating is below 25 A. Further work of the committee will therefore focus, among other things, on reviewing the future of the delivery concession system.

The electricity generation market is highly concentrated, and the merger of Gullspång Kraft and Stockholm Energi to form the Birka Energi company has strengthened this further. However, the Nordic countries now forming a common market comprising a larger number of companies that compete with one another, counteract the market concentration.

Network tariffs and electricity trading prices

The Energy Administration is entrusted with the task of monitoring price levels, price developments and other conditions for the network service, in order to safeguard consumer interests as regards low and stable prices. Information on tariffs and prices is gathered from all network utilities in the country and from the electricity trading companies that have delivery concessions. The Energy Administration can instruct companies to lower their tariffs if they are considered to be unreasonably high.

Network charges and electricity trading prices between 1997 and 1998 were basically stationary for small domestic consumers. This is due to the fact that it was not profitable in the short term for these consumers to change over to a different electricity supplier. On the other hand, the difference between the highest and lowest charges decreased, although the scatter among the various companies is still wide.

After the electricity prices were scrutinized by the Energy Administration in 1998, the companies lowered their prices to consumers whose consumption was low, i.e. mainly customers living in apartments and single-family dwellings without electric heating. Companies that were not subject to scrutiny also lowered their electricity prices during the year. The development of network tariffs and electricity trading prices is continually subjected to follow-up by the Energy Administration, and a renewed measurement of electricity prices made in October 1998 resulted in demands for further price reductions. The annual follow-up of the network tariffs and electricity prices by the Energy Administration leads to the consumers receiving a growing amount of price information and to improved transparency on the electricity market.

The electricity system

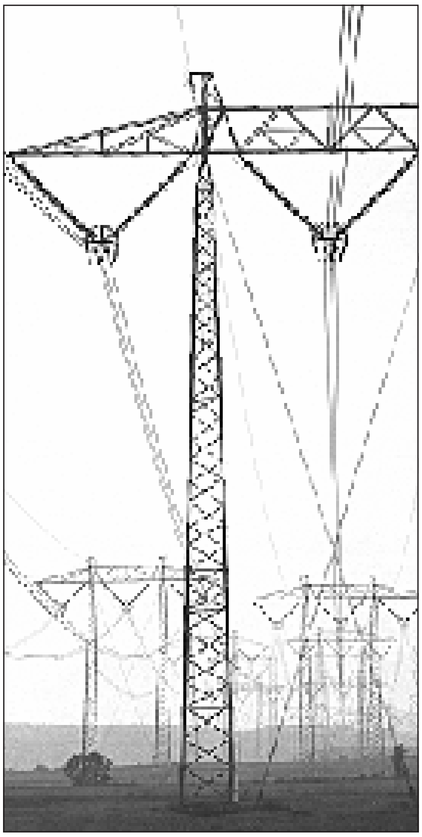
In the Swedish system, electricity from the power stations is carried to the users on the transmission and distribution network. The network is divided into three levels, i.e. the national grid, regional networks and local networks. The Svenska Kraftnät authority is responsible for the grid, which consists of around 16 000 km of 220 kV and 400 kV transmission lines with stations, and for most of the links with the neighbouring Nordic countries.

A condition for the electricity market performing as intended is that all players are given free access to the country’s transmission network. At the same time, a grid operator is needed to ensure, independently of other players on the market, that the transmission system continuously maintains a balance between the electricity produced and the electricity consumed. The Svenska Kraftnät authority is responsible for the system in Sweden.

New law

The new Electricity Act (1997:857) came into force on 1 January 1998. Rules for consumer protection in the purchase of electricity are included in a separate chapter, which introduces into the Electricity Act provisions for damages in the event of disturbances and interruptions. The Act also includes new provisions concerning trade with other countries, for the purpose of strengthening the check on new links with foreign countries.

The rules concerning the supervision of the electricity market have been clarified, principally in the matter of supervising the reasonableness of the terms for network services and electricity deliveries. The new Electricity Act has given the Energy Administration direct responsibility for monitoring the charges and other terms applied to electricity deliveries taking place within the delivery concession. ■



The supply of electricity in Sweden is based on hydro power, nuclear power, combined heat and power generation in district heating networks and in industry, oil-fired power and gas turbines. Hydro power and nuclear power normally account for around 95% of the electricity produced. Oil-fired condensing plants and gas turbines are normally run only temporarily during peak load periods, such as on cold winter days.

Figure 3 shows the electricity balance, week by week, during 1997 and 1998. The supply side is broken down into hydro power, nuclear power, and thermal power, etc. The figure also shows how electricity consumption was distributed over the year. The annual overhauls of the nuclear power units are scheduled for the summer, when the electricity demand is at its lowest. The water reservoirs are filled during the spring and summer, and the water stored is then used during the winter and up to the spring floods. When hydro power and nuclear power output is insufficient, the make-up power needed is generated in conventional thermal power plants or is imported.

During 1998, hydro power accounted for 48% of total production, nuclear power for 46% and the fossil-fired and biofuel fired generation for just over 6%. Total electricity generated increased by 6.1% compared to 1997 and amounted to 154.2 TWh, which is the highest value ever recorded. This is due to the fact that 1998 was an extremely wet year. Electricity consumption increased by only 0.6%, and net exports during 1998 totalled 10.7 TWh, compared to 2.6 TWh during 1997.

The gross installed hydro power output in 1998 totalled 16 204 MW, as shown in Table 2. The total net power generated by the country's nuclear power reactors amounted to 10 052 MW. The installed power in the combined heat and power stations of the district heating networks amounted to 2 246 MW. The power in industrial combined heat and power plants totalled 841 MW, and that in oil-fired condensing plants amounted to 340 MW. Most of the oil-fired condensing power stations were mothballed during 1998. Due to the stiff competition on the market, power utilities consider themselves unable to afford to operate these power stations, since they are only used for peak-lopping and thus serve as stand-by capacity. The new open Nordic electricity market enables the companies to

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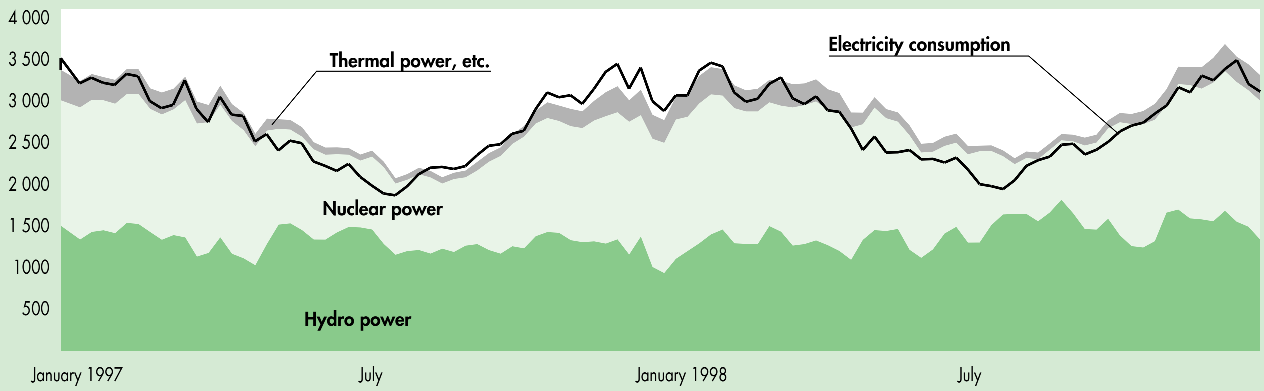
Figure 3 • Electrical energy generation, incl. electric boilers, and consumption during 1997 and 1998, GWh per week



Source: Compilation of information from the Swedish Power Association.

Table 1 • Electrical energy balance between 1990 and 1998 and forecasts for 1999 and 2000, TWh

	1990	1991	1992	1993	1994	1995	1996	1997	1998	*1999*	*2000*
Generation[1]	142.2	142.6	141.5	141.5	138.6	143.9	136.0	145.3	154.2	*146.7*	*142.5*
Hydro power	71.5	62.3	73.2	73.8	58.4	67.0	51.0	68.2	73.6	*66.3*	*63.8*
Wind power	0.01	0.01	0.04	0.05	0.08	0.10	0.14	0.20	0.30	*0.43*	*0.48*
Nuclear power	65.3	73.5	60.8	58.8	70.1	67.0	71.4	66.9	70.5	*69.9*	*67.8*
Other thermal power[3]	5.6	6.7	7.5	8.8	10.0	9.8	13.5	10.0	9.9	*10.1*	*10.4*
CHP in district heating networks	2.1	3.2	3.5	4.8	5.2	5.5	5.4	5.4	5.1	*5.3*	*5.6*
CHP in industry	3.1	3.1	3.3	3.5	3.8	3.8	4.5	4.0	4.5	*4.5*	*4.5*
Condensing power	0.3	0.3	0.6	0.4	0.9	0.4	3.6	0.6	0.3	*0.3*	*0.3*
Gas turbines, diesels, etc.[2]	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	*0.0*	*0.0*
Consumption[3]	139.7	141.2	139.5	140.9	138.9	142.2	142.2	142.7	143.5	*144.4*	*144.7*
Contracted deliveries	120.0	123.4	122.3	125.1	126.7	129.4	-	-	-	-	-
Interruptible deliveries[4]	9.0	8.3	8.4	7.4	4.1	4.4	-	-	-	-	-
Network losses	10.7	9.4	8.7	8.2	8.0	8.3	9.4	9.8	9.6	*9.5*	*9.3*
Imports - exports[5] (additional electricity demand)	-2.5	-1.4	-2.1	-0.8	0.3	-1.7	6.1	-2.6	-10.7	*-2.3*	*2.3*

[1] Net generation, i.e. excluding own consumption.
[2] The item is redefined compared to 1996 and covers only gas turbines that serve as stand-by for the power system.
[3] Due to rounding-off, the total sums do not always agree with the sum of the individual items.
[4] Reporting of the total deliveries to interruptible electric boilers has ceased as from May 1996.
[5] For the years 1990 - 1993, the information also includes a statistical carry-over.

Source: For the years 1990 - 1996, *Energiläget 1998 (Energy in Sweden 1998)*, Energy Administration. For the years 1997 - 2000, *Energiförsörjningen i Sverige 990301 (Energy supply in Sweden, 1 March 1999)*, Energy Administration.

import electricity from neighbouring countries instead. The installed gas turbine capacity amounted to 1350 MW. Around 87 additional wind power units came on stream in 1998, which brought total installed power to 174 MW.

Water inflow rules the Swedish electricity generation system

Total electricity demand in Sweden is normally met by domestic power generation. During 1996, electricity generated by hydro power was particularly low at 51 TWh, since the year was dry and the water inflow was low. In a normal year the figure amounts to around 64 TWh. The loss of hydro power generation capacity was compensated by other power generation and by 6 TWh net imports. However, 1997 and 1998 were wet years with higher water inflow than normal, which contributed to high net exports from the Swedish electricity generation system. In 1998, electricity generation exceeded consumption during most of the year. Figure 4 shows the weekly generation and consumption for the period between 1996 and 1998. ■

FACTS

Thermal power - power generated in a power station in which heat is converted into electricity. This includes condensing power, nuclear power and combined heat and power, CHP. Conventional thermal power excludes nuclear power.

Combined heat and power, CHP - generation in a power station that produces both electricity and heat for an adjacent district heating network or for industrial processes.

A gas turbine plant is basically a "jet engine" that drives a generator. The main fuel used in Sweden is light fuel oil.

Condensing power station - a power station equipped with condensing steam turbines. The stations generate only electricity. The power stations in Sweden are fired mainly with oil. Condensing power is also generated in CHP stations with recoolers.

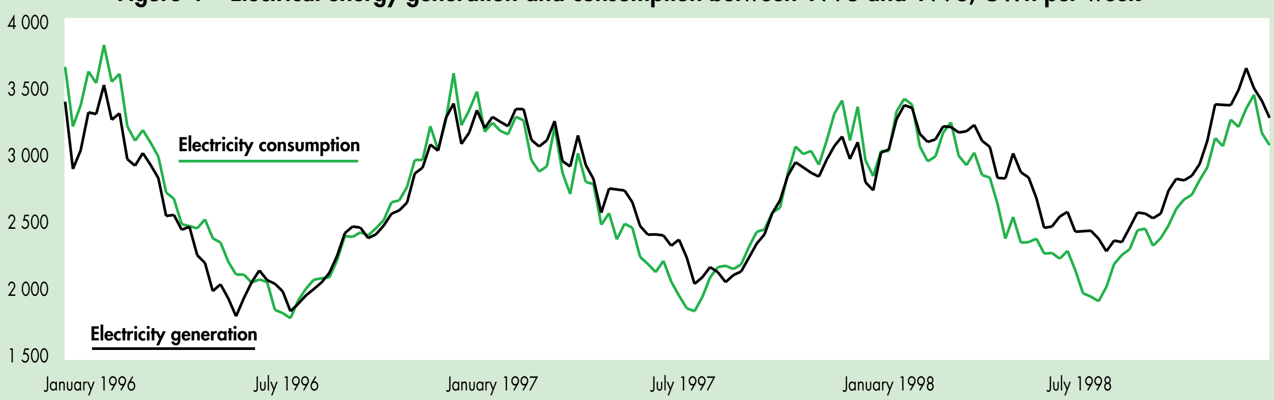
Hydro power station - power station that converts the potential energy of water into electricity.

Nuclear power - power generated in a condensing power station that uses heat from nuclear energy to generate electricity.

Wind power plant - a power plant that converts wind energy into electricity.

Natural gas combined cycle - a combined gas turbine and steam turbine plant fired with natural gas.

Figure 4 • Electrical energy generation and consumption between 1996 and 1998, GWh per week



Source: Compilation of information from Swedish Power Association.

Table 2 • Maximum energy generated during a normal year, TWh, and net output of Sweden's generation plants in 1998, MW

	Theoretical maximum energy generated during a normal year	Net output at year end
Hydro power	63.8 [1]	16 204 [2]
Nuclear power	72.0	10 052
CHP in industry	5.0	841 [3]
CHP in district heating networks	8.9	2 246 [3]
Oil-fired condensing power	3.0	340
Gas turbines	3.9	1 350
Wind power	0.4	174
Total	**157**	**31 207**

[1] Generation during a normal year is based on the mean value of water inflow for the period between 1950 and 1990. During extremely dry years, hydro power generation may amount to 51 TWh. During extremely wet years, the energy generated may increase to around 78 TWh.

[2] During the high-load period in the winter, output is limited to 15 500 MW by the instantaneous reserve (500 MW) and by hydrological limitations (550 MW). Due to the capacity of the transmission system, hydro power generation capacity is limited further to between 12 000 and 14 000 MW.

[3] The outputs are calculated from the specified main fuel. In other statistical sources, the net output can be specified on the basis of possible fuels, e.g. oil. Since the efficiency on oil firing is higher, outputs calculated in such a manner will be higher than those given in the table.

Source: Processed information from the Energy Administration, Statistics Sweden and the Swedish Power Association.

The development of electricity consumption depends on the growth of the national economy. Since the early 1970s, electricity consumption has increased by an average of 3% annually. The rate of increase was high in the 1970s, but tapered off in the 1980s. Between 1990 and 1997 actual electricity consumption increased by a total of 2%, whereas temperature-corrected consumption remained basically unchanged. In 1997 electricity consumption amounted to 142.7 TWh, which represents an increase of 0.5 TWh on 1996. According to preliminary figures, electricity consumption during 1998 increased by 0.6%. The sector comprising dwellings, services, etc. now accounts for around half of total electricity consumption, while industrial consumption amounts to just over one third.

Industry

Electricity consumption in industry is linked to the economic activity in various industrial sectors. During the 1980s, industrial production grew at a rate of about 2% annually, and electricity consumption at a rate of around 3% annually. During the recession in the early 1990s, industrial production declined by an average of 4.5% annually, which led to a downturn in electricity consumption by just under 3% annually between 1990 and 1993. During 1997, electricity consumption in industry increased by 3.5% compared to 1996 reaching 52.7 TWh and amounted to 53,8 TWh in 1998. The upturn is due mainly to a high growth rate in the pulp and paper industry.

Electricity consumption varies from one industrial sector to the next. Electricity-intensive industries, such as the mining industry, pulp and paper industry, the basic chemicals industry, ironworks and steelworks, currently account for almost 60% of total industrial electricity consumption. The consumption of the engineering industry amounted to 13%. Slightly less than 90% of the electricity in industry is used for processes and for driving motors.

Residential, commercial and service sector

In the residential and services sector, electricity is used for heating in single-family and multi-family dwellings, and in commercial and public premises, for domestic electricity in dwellings and for appliances in commercial and public premises. The electricity used for street and road lighting, and for water and sewage treatment is also included.

Electric space heating currently accounts for just under 40% of total electricity consumption in the sector. Actual consumption for electric heating varies from year to year, depending on factors such as temperature conditions. During the period between 1990 and 1997, use of electricity for space heating decreased by an average of 1.1% annually in temperature-corrected terms. During 1997, electric heating declined by 7.7% compared to 1996 and amounted to just over 27.5 TWh. The downturn is due mainly to temperature differences between the years. 1996 was colder than a normal year, and 1997 was warmer. The temperature-corrected consumption of electricity for space heating dropped during 1997 by 1.7% compared to 1996.

Domestic electricity accounts for 27% of total electricity consumption in the sector, and amounted to 19 TWh in 1997. This consumption increased by 2.1 TWh between 1990 and 1997. Electricity consumption in the services sector, such as offices, schools, retailers and hospitals, increased by a total of 5.6 TWh between 1990 and 1997, and amounted to 24.6 TWh in 1997. This increase is due mainly to the growing numbers of electrical equipment, such as computers.

Transport

In the transport sector, electricity is used mainly for powering trains, trams and underground trains. The transport sector accounts for a very small proportion of total national electricity consumption, and today amounts to less than 2%. Consumption between 1990 and 1997 has remained relatively stable at around 2.5 TWh.

District heating and refineries

Consumption of electricity in the district heating sector consists mainly of supplies to electric boilers and power supplied for driving heat pumps. Supplies to electric boilers dropped from 6.2 TWh in 1990 to 1.8 TWh in 1997. During the same period, electricity supplied for driving heat pumps remained stable at around 2 TWh. Electricity consumption in refineries is relatively constant and amounted to 0.8 TWh in 1997.

Forecast for the years 1999 and 2000

The forecasts in Table 3 are based on energy policy decisions taken by the Riksdag, implying that today's taxation and charge system is expected to remain unchanged during the entire forecast period. Calculations are based on the assumption that one reactor in Barsebäck will be decommissioned on 1 July 1999 implying a generation loss of 2.1 TWh in 1999 and 4.2 TWh during the year 2000. ■

Table 3 • Electricity consumption between 1990 and 1997, and forecasts up to the year 2000, TWh

	1990	1991	1992	1993	1994	1995	1996	1997	*1998*	*1999*	*2000*
Industry	53.3	50.9	49.8	49.0	50.2	51.7	50.9	52.7	*53.8*	*53.8*	*54.4*
of which pulp and paper industry	20.0	19.2	19.0	19.3	19.1	19.1	19.3	20.5	*21.1*	*20.9*	*21.1*
basic chemical industry, etc.	6.2	5.6	5.5	5.2	5.5	5.6	5.5	5.8	*5.9*	*6.0*	*6.1*
ironworks and steelworks	4.8	4.4	4.4	4.4	4.7	5.0	4.9	5.0	*5.0*	*5.0*	*5.0*
engineering industry	7.2	6.5	6.6	6.6	6.6	7.1	7.0	7.0	*7.1*	*7.1*	*7.2*
Dwellings, services, etc.	63.3	68.5	68.5	71.3	71.2	72.3	73.0	71.1	*70.8*	*71.7*	*71.7*
of which electric heating	27.4	27.7	28.0	27.7	28.1	26.9	29.8	27.5	*27.0*	*27.7*	*27.5*
domestic electricity	16.9	17.4	17.3	17.3	17.5	17.5	18.1	19.0	*19.1*	*19.2*	*19.3*
electricity for appliances	19.0	23.4	23.2	26.4	25.5	27.9	25.1	24.6	*24.7*	*24.8*	*24.9*
Transport	2.5	2.5	2.5	2.5	2.6	2.5	2.5	2.4	*2.5*	*2.5*	*2.6*
District heating, refineries	10.0	9.9	10.0	9.7	6.9	7.5	6.3	6.7	*6.8*	*6.9*	*6.7*
Conversion and distribution losses	10.7	9.4	8.7	8.2	8.0	8.3	9.4	9.8	*9.6*	*9.5*	*9.3*
Total net consumption	139.7	141.2	139.5	140.9	138.9	142.2	142.2	142.7	*143.5*	*144.4*	*144.7*
Total net temperature-corrected consumption	143.1	142.5	141.5	141.9	139.9	142.4	141.0	143.3	*144.4*	*144.4*	*144.7*

Source: For the years 1990 - 1996, information has been obtained from *Energiläget 1997 (Energy in Sweden 1997)*, National Energy Administration, and for the years 1997 - 2000, from *Energiförsörjningen i Sverige, 990301 (Energy supply in Sweden, 1 March 1999)*, National Energy Administration.

Sweden has more than 700 large hydro power stations, each with an installed output of more than 1.5 MW, and around 1200 small hydro power stations. The small stations generate a total of around 1.5 TWh. The rivers in northern Sweden account for 88% of Sweden's total hydro power generation.

During a normal year, hydro power produces 63.8 TWh of electricity, including losses, which corresponds to 45% of the electricity generated in the country. The electricity generated by hydro power can vary widely over the year and from one year to the next. During extremely dry years, production may amount to no more than 51 TWh, while in extremely wet years, it could total 78 TWh. Scope is also available for storing water in reservoirs for shorter or longer periods. The maximum volume stored in long-term reservoirs corresponds to 33.6 TWh.

The highest annual production of hydro power in Sweden was recorded during 1998 and amounted to 73.6 TWh. During 1997, hydro power generated 68.2 TWh and accounted for 47% of electricity generated in the country. In 1996, which was an extremely dry year, hydro power generated 51 TWh, which corresponded to 38% of the total electricity generated.

High water inflow

Just like most other years in the last decade, 1998 was a wet year. While the water inflow was normal during spring, it was between 1.5 and 3 times higher than normal in the summer on a weekly basis. The inflow during the year corresponded to a total of 85.8 TWh, compared to 60.3 TWh in a normal year. The water inflow in 1997 amounted to 69 TWh.

Reservoir contents

The reservoir contents during the period between 1994 and 1997 were lower than average, except for a brief period in 1995. This is not because the precipitation was unusually low during these years, but because the power utilities chose to use water for generating more power instead of storing it. The tendency appears to be that power utilities assign greater priority than in the past to higher production rather than higher volumes in the reservoirs.

The reservoir contents were consistently lower than average in both 1996 and 1997, which is illustrated by Figure 6. Early in 1997, the reservoirs were 53% full, which corresponds to 17.6 TWh. Due to the cold weather, the water reservoirs were not filled until the beginning of June. During an average year, Swedish water reservoirs are usually around 33% full by the middle of May, while in 1996 and 1997, they were no more than 20% full at about the same date.

Early in 1998, the reservoirs were 51% full, which corresponds to 17.1 TWh and is well below the average for the time of year. The water inflow during the spring was largely normal, with the exception of two weeks in February, when it was three times higher than normal. Due to extreme inflow during the summer, the volumes stored in the reservoirs were higher than normal in the middle of July.

At the end of 1998, the reservoirs were 73.2% full, which corresponds to 24.6 TWh or 2 TWh above average. The volume of water stored in the reservoirs at about the same time in 1997 was 7.4 TWh higher. Due to the extreme inflow during the late summer of 1998, the power utilities were obliged to spill water past the power stations in order to lower high water levels in some of the rivers in northern Sweden.

New investment grant for small-scale hydro power

The energy policy decision in June 1997 included an investment grant appropriation for small-scale hydro power. The appropriation amounts to SEK 150 million for a five-year period beginning on 1 July 1997. The grant amounts to 15% of the investment cost. This measure is expected to be capable of yielding 0.25 TWh of new electricity generation capacity. No grants have been paid during 1997 or 1998 due to doubts concerning the environmental demands that would be made on the plants if they were to qualify for the grant. These doubts have now been clarified, and processing of the applications received has begun. By February 1999, more than 20 applications have been received by the Swedish National Energy Administration. ■

Table 4 • Electrical energy generated by hydro power on various rivers between 1990 and 1997, TWh, and installed power on 31 December 1997, MW

	1990	1991	1992	1993	1994	1995	1996	1997	MW, 1997
Lule River	15.8	13.4	17.2	16.4	13.2	14.0	14.1	16.0	4 355
Skellefte River	4.8	4.3	4.9	5.3	3.7	4.5	3.4	4.4	1 023
Ume River	9.3	7.7	8.6	9.3	6.9	8.0	5.4	8.3	1 743
Ångerman River	9.4	7.7	8.9	9.6	6.9	7.8	5.5	8.0	1 771
Fax River	4.7	3.6	4.6	4.3	3.0	4.3	2.8	4.0	806
Indal River	9.7	9.0	11.4	9.6	8.2	9.8	7.5	10.2	2 096
Ljungan	1.9	1.8	2.1	2.3	1.6	2.0	1.6	2.1	606
Ljusnan	3.5	3.4	3.5	4.0	3.1	3.8	3.2	3.7	803
Dal River	4.7	3.7	4.3	4.9	4.4	4.6	3.1	4.4	1 090
Klar River	2.3	2.1	2.0	2.3	2.1	2.4	1.9	1.6	375
Göta River	1.4	1.2	1.2	1.5	1.7	2.0	0.9	1.4	371
Other rivers	3.9	4.5	4.0	3.8	3.1	3.8	1.6	4.0	1 206
Total	**71.4**	**62.4**	**72.7**	**73.3**	**57.9**	**67.0**	**51.0**	**68.1**	**16 246**

Note: Totals for production differ somewhat from official statistics. Fax River is within the water system of Ångerman River.

Source: Summary of information from the Swedish Power Association.

Figure 5 • Water inflow during a normal year, and in 1997 and 1998, GWh per week

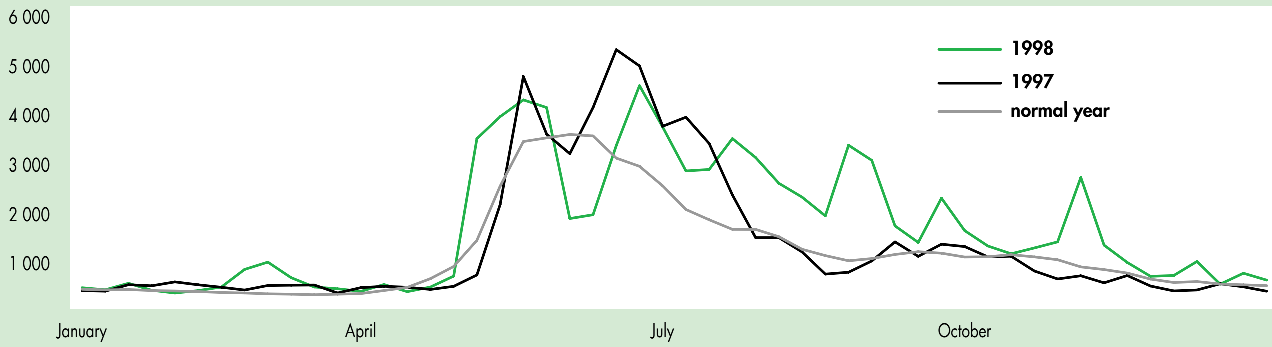


Figure 6 • Reservoir contents during a normal year, and in 1996-1998, percent

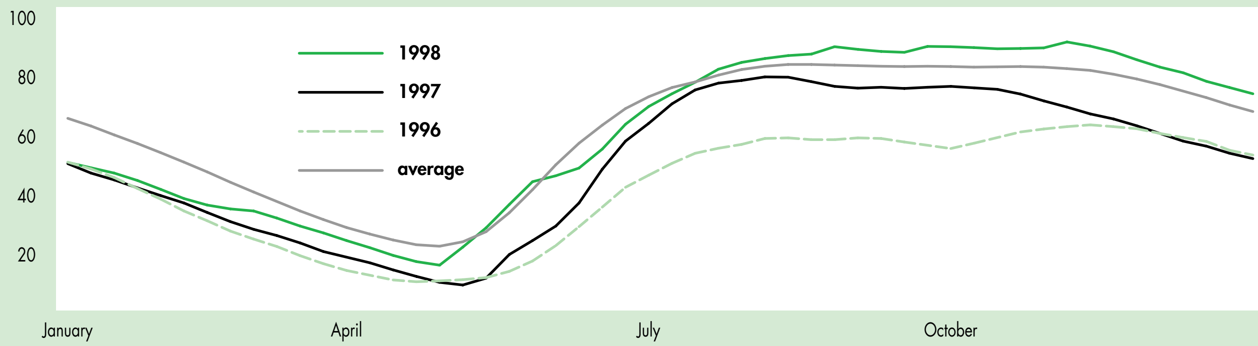
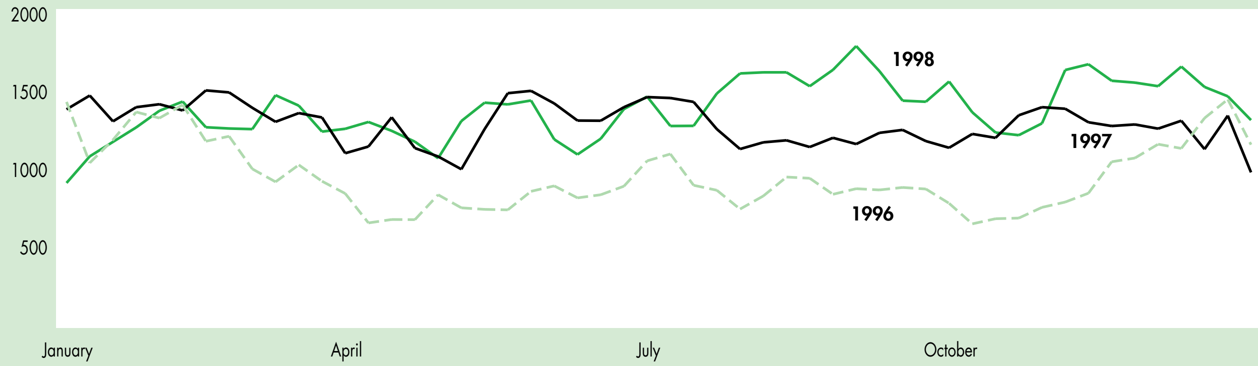


Figure 7 • Hydro power generation in 1996-1998, GWh per week



Source for figures 5-7: Summary of information from *Sveriges elförsörjning (Sweden´s electricity supply)*, Vattenfall and Swedish Power Association.

Sweden has four nuclear power stations in operation, with a total of 12 reactors. The energy generated in a nuclear power station is determined by the availability of the plant and by its maximum power output. However, thermal loading and ratings of the generators limit maximum power. Raising the output of the nuclear power stations can increase the electricity generated. In practice, uprating often presupposes modifications and additions to the reactor safety system.

Availability and energy utilization

Availability is determined by the unscheduled outages and by annual overhaul shut-downs. During the overhaul shut-down, which takes place in the summer when electricity demand is a minimum, maintenance and inspection work are done on the reactors, and the reactors are also refuelled. The overhaul normally takes around four weeks and reduces the maximum annual energy availability to 85 - 90%.

The degree of energy utilization in nuclear power reactors is restricted by load reduction and by coast-down. Load reduction involves lowering the power output of the plant for economic reasons. The amount of load reduction is dependent on factors such as availability of hydro power and demand for electricity.

Coast-down involves adjusting the degree of enrichment of the fuel, with the aim of minimizing fuel costs. Coast-down is also done for economic reasons, and can be eliminated by modified reloading. As a result of variations in the demand for electricity, it is not economical to load the reactors so that maximum output will be achieved. Loading is therefore adjusted so that generation capacity of the reactors gradually declines during a period of a few weeks prior to every overhaul shut-down.

Load reduction and coast-down will become more costly as other types of power with higher variable generation costs are added to the power system. As demand increases, load reduction may thus be expected to become less extensive.

High nuclear power generation in 1998

The energy generated by nuclear power in 1998 amounted to 70.5 TWh and accounted for 46% of total electricity produced. Compared to this, nuclear power supplied 66.9 TWh in 1997. Nuclear power then also accounted for 46% of total electricity generated, which is due to hydro power production not being as high in 1998. In earlier years, the extent of nuclear power generation was controlled by the magnitude of hydro power production. During years when hydro power generation was low, nuclear power production was high and vice versa. However, 1998 was an exception, since both hydro power and nuclear power generation were high compared to production in a normal year.

The average availability of the Swedish reactors in 1998 was around 85%, which is an improvement on the year before. The equivalent international mean value for these reactor types is 74%. In seven of the twelve reactors, the energy availability exceeded 90%.

High energy availability during 1998 was largely due to the fact that several of the annual overhaul shut-downs in 1997 were longer than expected. In addition, the 1997 overhauls on Forsmark 1 and 2 were the most comprehensive ever undertaken. According to a decision by SKI, the Nuclear Power Inspectorate, Oskarshamn 1 needed no overhaul shut-down during 1997, but the 1998 shut-down was brought forward, thereby lowering the energy availability of this reactor during the year. The reactor is under special supervision by SKI after undergoing an extensive overhaul. All reactors otherwise exceeded the international mean value for energy availability.

As a consequence of low water inflow and low levels in the water reservoirs, load reduction during 1996 and 1997 was not applied to any significant extent. During 1997, production was reduced by 2.1 TWh due to coast-down. Statistics for 1998 are not yet available.

Nuclear power decommissioning was not started in 1998

The Riksdag passed the Nuclear Power Decommissioning Act in December 1997. In February 1998, the Government decided that

Table 5 • Production data for Swedish nuclear power reactors in 1997

Reactor	Net output, MW	Production, TWh Max. available [1]	Production, TWh Actual [2,3]	Losses [4], TWh Coast-down	Losses [4], TWh Load reduction	Losses [4], TWh Overhaul	Losses [4], TWh Other outages
Barsebäck 1	600	3.8	3.7	0	0	1.0	0.4
Barsebäck 2	600	4.0	3.9	0	...	0.7	0.5
Forsmark 1	968	5.9	5.4	0.5	0	2.4	0.1
Forsmark 2	969	7.5	7.3	...	...	0.8	0.3
Forsmark 3	1 158	9.1	9.0	...	...	0.9	0.3
Oskarshamn 1	445	3.0	2.9	0	...	0.7	0.3
Oskarshamn 2	605	4.6	4.4	0.1	...	0.6	0.3
Oskarshamn 3	1 160	9.2	9.0	...	0.1	0.8	0.2
Ringhals 1	835	2.4	2.2	0.1	0	4.2	0.7
Ringhals 2	875	6.9	6.2	0.6	...	0.6	0.2
Ringhals 3	918	6.9	6.6	0.2	0	0.5	0.7
Ringhals 4	923	7.0	6.4	0.6	...	0.9	0.1
Total	**10 056**	**70.3**	**66.9**	**2.1**	**0.2**	**14.2**	**4.1**

[1] Net output x availability of the reactor x 8 760 hours

[2] Net output x utilization of the reactor x 8 760 hours

[3] Due to rounding-off in the calculation source material, the particulars do not agree with the statistics given in other tables. In addition, the statistics were obtained at different dates.

[4] Losses are defined as those that are not availability-dependent (coast-down, load reduction, effect of cooling water temperature and external faults) and those that are availability-dependent (periodic tests, faults and overhauls). Other outages include both types of losses, in which the effect of cooling water temperature, external faults, periodic tests and faults have been added together.

... less than 50 GWh.

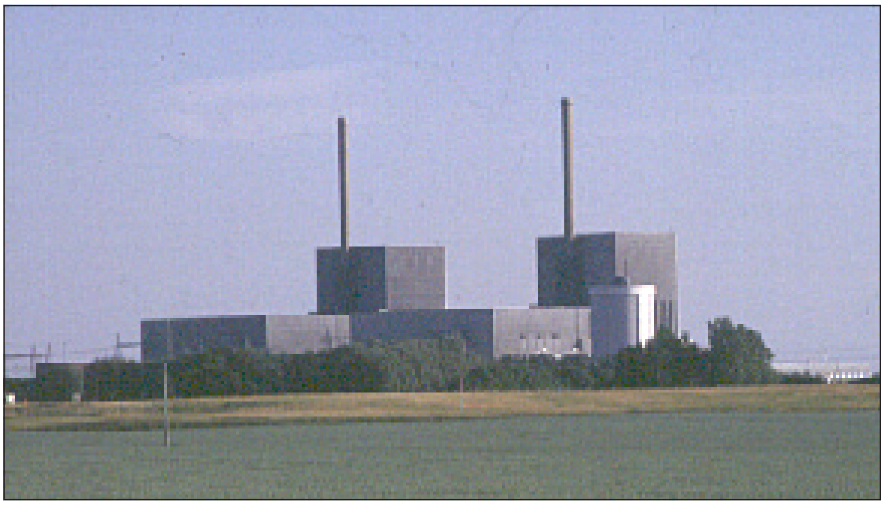
Note: Due to rounding-off, the actual production does not agree with the maximum available production - coast down - load reduction.

Source: Summary of information from Kärnkraftssäkerhet och Utbildning AB - a company that specializes in nuclear safety and training.

Barsebäck 1 would be shut down no later than by the end of June 1998. In addition, Barsebäck 2 was to be decommissioned in the year 2001, provided that reduced electricity consumption and an increased supply of electricity from other sources could compensate the loss of generation capacity. No date was decided for complete nuclear power decommissioning. However, the Supreme Administrative Court decided in 1998 to postpone the implementation of the decision to shut down the Barsebäck 1 nuclear power reactor in June 1998. A comprehensive energy policy programme was started in order to facilitate the change-over in the supply and utilization of electricity and other forms of energy. The work of implementing most of the programme and coordinating the change-over work is being managed by the National Energy Administration.

Operating permits for nuclear power stations

The operating permits for the Swedish nuclear power plants vary in the duration of their validity period. According to SKI, Barsebäck 1 has an operating permit of unlimited duration, whereas that for Barsebäck 2 is up to and including the year 2010. The operating permits for other reactors in Sweden are valid up to and including the year 2010, with the exception of Oskarshamn 1 and 2, the operating permits of which are of unlimited duration, and Ringhals 1 and 2 whose permits are valid up to the year 2000 and 2005 respectively. ■



FACTS

The annual generation potential of a reactor is calculated as the number of hours of operation per year, multiplied by the maximum output of the plant. Since a power station itself needs electricity for its operation, a distinction is made between gross and net power output. In Swedish reactor plants, the average net output is around 95% of the gross output.

There are two different ways of measuring the efficiency of a nuclear power station, i.e. utilization and availability.

Energy utilization specifies the relationship between the actual electricity generated and the theoretically attainable generation of electricity over a certain period of time. This is important for the valuation of the economy of the plant, and thus of the production costs.

Energy availability specifies the actual period of time during which the generator has been synchronized to the grid, regardless of its output.

Table 6 • Net electricity generated during the years 1990 to 1998, TWh

	Commissioned in	1990	1991	1992	1993	1994	1995	1996	1997	1998	Total energy since commissioning, TWh	Availability in 1998, percent
Barsebäck 1	1975	4.3	4.5	3.1	3.2	4.4	3.9	4.1	3.7	4.3	90.2	85.8
Barsebäck 2	1977	4.2	4.6	2.6	2.9	3.7	3.4	3.8	3.9	4.0	84.5	81.7
Forsmark 1	1980	6.2	7.4	6.8	7.0	7.4	7.3	7.3	5.4	7.3	119.2	93.8
Forsmark 2	1981	6.4	7.1	6.7	6.7	7.7	7.1	7.3	7.3	7.2	115.4	92.1
Forsmark 3	1985	7.9	8.6	8.1	8.3	9.2	8.9	8.8	9.0	9.0	112.3	93.9
Oskarshamn 1	1972	2.5	3.3	1.8	0.0	0.0	0.0	2.4	2.9	1.3	62.6	32.7
Oskarshamn 2	1974	4.0	4.1	2.9	2.6	4.5	4.2	3.8	4.4	4.4	93.7	90.2
Oskarshamn 3	1985	7.6	8.9	8.2	8.3	8.5	8.9	8.5	9.0	8.0	110.4	89.4
Ringhals 1	1976	4.5	5.6	3.3	4.0	5.4	5.7	6.5	2.2	5.6	102.1	84.7
Ringhals 2	1975	5.2	6.1	5.3	2.7	6.3	6.1	5.7	6.2	6.1	108.9	90.4
Ringhals 3	1981	5.9	5.9	5.6	6.7	6.9	4.9	6.8	6.6	6.4	96.2	90.1
Ringhals 4	1983	6.5	7.0	6.5	6.4	6.2	6.3	6.3	6.4	6.8	94.1	92.4
Total		**65.2**	**73.2**	**60.9**	**58.6**	**70.2**	**66.7**	**71.3**	**66.9**	**70.5**	**1 119.2**	**84.8**

Source: Compilation of information from the Swedish Power Association.

Conventional thermal power stations are fired with fossil fuels, oil, coal, natural gas or biofuels, peat, etc.

During 1996, the electricity generated by fossil fuels and biofuels, peat, etc. amounted to 13.5 TWh, which corresponds to almost 10% of the total electricity generated in the country. Seen from a historical perspective, this was a high proportion, which was due to low hydro power production. The corresponding figures for 1998 were 9.9 TWh and 6.4% respectively. CHP stations in district heating networks delivered 5.1 TWh of electricity during 1998. Industrial CHP stations supplied 4.5 TWh.

In the CHP stations in district heating networks, coal and blast furnace gases accounted for 48% and oil for 27% of total fuel supplied for electricity generation in 1997. Natural gas and biofuels, peat, etc. accounted for 8% and 17% respectively. The use of oil and biofuels dominated in industrial CHP plants. These accounted for 49% and 46% respectively of total fuel supplied for electricity generation. Natural gas accounted for 3% and coal for 2%.

A large proportion of Swedish stand-by generation capacity was mothballed in 1998. On 1 January 1999, the remaining oil-fired condensing capacity was only around 340 MW, and gas turbine capacity was approximately 1350 MW.

More than 80 new wind power units were installed in 1998. The electricity supplied by wind power during 1998 amounted to 0.3 TWh, which represents a 50% increase on 1997. Wind power accounted for 0.19% of total electricity generated in the country during 1998. At the end of 1998, there were 421 wind power units with an installed capacity of 174 MW. By 31 December 1998, a total of 117 investment grant applications for wind power plants had been received. Out of these, 100 (143 units) have been awarded grants and the remainder are now being processed. These units together will provide an additional capacity of 302 GWh, which represents 60% of the target value of 500 GWh. Out of the SEK 300 million appropriation, these applications would account for SEK 178 million or 60%. The 143 wind power units for which grants have been awarded during the year are expected to produce around 225 GWh. The installed power of these units is 101 MW.

Biofuel grants

Investment grants administered by the National Energy Administration are available for biofuel-fired CHP plants. Grants are available for investments that provide a new contribution to electricity generation. The total appropriation for grants is SEK 450 million for the period between 1 July 1997 and 30 June 2002, and should achieve an increase of at least 0.75 TWh on the annual electricity generated by biofuel-based CHP plants.

Up to the end of 1998, a total of 24 applications had been received. Out of these, six have been awarded grants, two have been withdrawn, and four have been disallowed. A further two have been disallowed early in 1999. Out of the remainder, eight applications are being processed, while the remaining two have not yet submitted the additional information required for the applications. The plants that have been awarded grants are expected to come on stream during the period between December 1999 and March 2001.

The six projects that have received grants will provide a gross power contribution of 84 MW, an estimated gross electricity production of 366 GWh (48.8% of the target) and will absorb SEK 217 million (48.2% of the capital available). ■

Table 8 • Electric power generated in conventional thermal power stations per fuel type in 1998, MW.

	MW	Percent
Oil	2 700	54
Natural gas, LPG and blast furnace gases	274	5
Coal, biofuels, peat, etc.	2 016	40
Total	**4 990**	**100**

Note: The power outputs are calculated from the specified main fuel. See also footnote 3 in Table 2.
Source: Processed information from Statistics Sweden (SCB) and the Swedish Power Association.

Table 7 • Electrical energy generated by conventional thermal power and wind power between 1990 and 1998, TWh, and net power output, MW

	1990	1991	1992	1993	1994	1995	1996	1997	1998	Net power MW, 1998
CHP in industry	3.1	3.1	3.3	3.5	3.8	3.8	4.5	4.0	4.5	841
CHP in district heating networks	2.1	3.2	3.5	4.8	5.2	5.5	5.4	5.4	5.1	2 246
Oil-fired condensing power	0.3	0.3	0.6	0.4	0.9	0.4	3.6	0.6	0.3	340
Gas turbines	0.1	0.1	0.1	0.1	0.1	0.1	0.02	0.01	0.01	1 350
Total	**5.6**	**6.7**	**7.5**	**8.8**	**10.0**	**9.8**	**13.5**	**10.0**	**9.9**	**4 777**
Wind power	0.005	0.013	0.044	0.048	0.078	0.10	0.14	0.20	0.30	174

Note: Power outputs are calculated from the specified main fuel. See also footnote 3 in Table 2.
Source: *Energiläget 1998 (Energy in Sweden 1998)*, National Energy Administration, and processed information from Statistics Sweden (SCB) and the Swedish Power Association.

Electric power generation accounts for only a small proportion of the emissions of atmospheric pollutants in Sweden, since more than 90% of the electricity supply is based on hydro power and nuclear power. The generation of electricity in hydro and nuclear power stations is not totally devoid of environmental impact, even if they do not give rise to environmentally harmful emissions during normal operation.

Carbon dioxide emissions

In 1996, electricity generation accounted for 9% of total carbon dioxide emissions in Sweden, compared to the normal value of 5%. The increase was due to the fact that fossil-fuelled generation capacity had to be put to greater use in order to compensate for the extremely low hydro power output during that year. In 1997, the carbon dioxide emissions from electricity generation amounted to 3 million tonnes, which represents a reduction of around 50% on 1996. The reduction is due to the fact that hydro power generation in 1997 was higher than normal. Preliminary statistics show that emissions in 1998 were roughly of the same magnitude.

No carbon dioxide tax is levied today on electricity generation. As a result, the most heavily taxed fuels are used for electricity generation in CHP plants, and untaxed fuels are used for heat generation. This has contributed towards an increase in the use of fossil fuels for electricity generation.

Nitrogen oxides and sulphur dioxide

The emissions of nitrogen oxides and sulphur dioxide from electricity generation in 1996 were 2% and 7% respectively of the total emissions of these substances within the country. However, the predominant part of sulphur and nitrogen oxide depositions, 93,5 % and 83,8 % respectively, are caused by emissions in other countries. The emissions of nitrogen oxides and sulphur dioxide have remained at a relatively constant level during the period between 1990 and 1995, and are dependent on the availability of water for electricity generation. Since 1996 was a dry year, the emission of atmospheric pollutants was higher than normal. By way of comparison, the emissions of nitrogen oxides and sulphur dioxide in 1997 were about 1% and 4% respectively. The emissions in 1998 are expected to be on a par with those in 1997.

The Riksdag has set up guidelines for the emission of nitrogen oxides from combustion plants. On appraisal, guidelines or limit values are determined for atmospheric emissions, including nitrogen oxide emissions, for each individual plant. Since 1992, an environmental charge is levied for emissions of nitrogen oxides (see also the section dealing with taxes).

Sulphur emissions have been reduced mainly by gradual lowering of the sulphur contents of fuel oils. The sulphur content of oil is regulated by a special ordinance. This also regulates the limit values for the sulphur in certain coal-fired plants. In addition, a sulphur tax is levied on fuels that contain sulphur (see also the section dealing with taxes). Sulphur and nitrogen oxide emissions lead mainly to acidification and over-fertilization.

Hydro power

Unlike the environmental impact caused by the emission of atmospheric pollutants, the environmental impact of hydro power is mainly local and regional. A decisive difference is also that the principal environmental impact is caused by the construction of plants rather than by operation. The construction of a hydro plant affects the environment by changing the landscape pattern, the biotopes, the local biological diversity, fisheries, care of cultural relics, and open-air activities. Any damage caused is difficult or impossible to repair and is not confined to the run of the river, but also affects the surrounding region.

Nuclear power

During normal operation, the generation of electricity in nuclear power stations gives rise to small emissions of radioactivity. The limit values for these emissions have been set so that persons who are subjected to the highest radiation levels will receive an annual dose not exceeding 0.1 mSv. Compared to this, the natural background radiation gives an annual dose of 4 mSv. During normal operation, the emissions from a nuclear power station are far below the limit value. The environmental impact of nuclear power consists principally of the risk of a more serious emission that could be caused by an accident. However, operation gives rise to radioactive waste which could cause environmental impact if it were not disposed of in an adequate manner.

Wind power, biofuels and peat

In a way similar to hydro power the environmental impact of wind power consists of the changes it causes to the landscape pattern. Vast areas are needed to secure a substantial addition to the total electricity generated. However, wind power units also have a certain environmental impact during operation, since they emit sound that may be perceived as disturbing. To some extent, radio communications can also be disturbed. There is no evidence of any other direct environmental effects.

Just as any other combustion, firing with biofuel causes emissions of atmospheric pollutants. However, this combustion of biofuel does not give rise to any net contribution of carbon dioxide to the atmosphere, provided that the biomass harvested does not exceed the growth rate. Biofuels are exempt from sulphur tax.

Combustion of peat gives rise to emissions of carbon dioxide and sulphur. By international standards peat is regarded as a fossil fuel and, when burned, is considered to give a net contribution of carbon dioxide to the atmosphere. Peat is subject to a sulphur tax. ■

Table 9 • Emissions of carbon dioxide, sulphur dioxide and nitrogen oxides during 1990 - 1997

	1990	1991	1992	1993	1994	1995	1996	1997
Carbon dioxide, million tonnes								
Electricity generation according to STEM[1]	1.4	2.0	2.4	2.7	3.4	2.9	5.8	3.0
Total in Sweden	**59.2**	**59.1**	**60.7**	**60.7**	**63.5**	**58.1**	**63.4**	**62.1**
Nitrogen oxides, thousand tonnes								
Electricity generation according to SCB	3	4	3	4	4	3	6	3
Total in Sweden	**396**	**394**	**402**	**398**	**392**	**355**	**356**	**336**
Sulphur dioxide, thousand tonnes								
Electricity generation according to SCB	4	4	4	4	5	4	7	4
Total in Sweden	**130**	**110**	**103**	**101**	**97**	**94**	**100**	**92**

[1] Statens Energimyndighet (STEM) – Swedish National Energy Administration

Source: Statistics Sweden (SCB) and Swedish National Energy Administration.

Trade in electricity takes place between various types of players. Generation utilities sell electricity to distributors, to end customers and to other generators. Distributors sell electricity to end customers, to other distributors and, in certain cases, to generators. Electricity is sold to customers in Sweden, and also to players in countries with which Sweden has transmission links.

From generation optimization to Nordic electricity exchange

Swedish power utilities have long had close cooperation. National joint operation can be said to have started in 1938 when power interchange began between Vattenfall and Krångede AB. Up to 1994, the major power generators had agreements concerning joint optimization of electricity generation. Temporary interchanges of power, within the framework of generation optimization, dominated sales among the generators. A new system was applied in 1995 in which, unlike earlier, all electricity generators were included in the interchange of power. This optimization ceased at the 1995/96 turn of the year, when the new Electricity Act came into force.

In January 1996, the existing electricity exchange in Norway, i.e. Statnett Marked AS, was made available to Norwegian and Swedish players on equal terms, and an office was opened in Stockholm. Statnett SF, the Norwegian grid, owned Statnett Marked AS utility. In April of the same year, the Svenska Kraftnät authority purchased 50% of the shares. In conjunction with this, the name of the company was changed to NordPool, the Nordic Electricity Exchange.

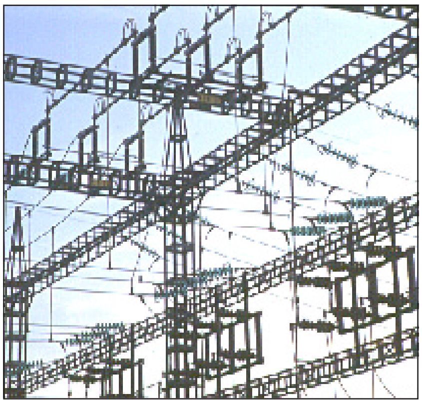
The Finnish electricity exchange, known as EL-EX, started operating in August 1996. In the early stages of its operations, the exchange had about 30 Finnish players. In September 1996, the Finnish IVS network utility took over responsibility for the northern links which, in practice, meant that they were opened to all players. As a result of free access to the transmission links, Swedish and Norwegian players are now free to purchase electricity in Finland and Finnish players can trade on the Swedish-Norwegian exchange.

Table 10 • Sweden's foreign trade in electricity between 1990 and 1998, TWh

		Denmark	Norway	Finland	Germany	Total
1990	imports	0.2	12.3	0.4	-	12.9
	exports	7.9	0.4	6.4	-	14.7
	imports-exports	*-7.7*	*11.9*	*-6.0*	-	*-1.8*
1991	imports	0.8	4.7	0.7	-	6.2
	exports	1.8	3.1	2.7	-	7.6
	imports-exports	*-1.0*	*1.6*	*-2.0*	-	*-1.4*
1992	imports	1.5	6.7	0.7	-	8.9
	exports	5.4	1.2	4.4	-	11.0
	imports-exports	*-3.9*	*5.5*	*-3.7*	-	*-2.1*
1993	imports	1.3	6.3	0.4	-	8.0
	exports	4.0	0.5	3.1	0.9	8.5
	imports-exports	*-2.7*	*5.8*	*-2.7*	*-0.9*	*-0.5*
1994	imports	1.9	4.5	0.3	-	6.7
	exports	0.7	2.8	1.7	1.2	6.4
	imports-exports	*1.2*	*1.7*	*-1.4*	*-1.2*	*0.3*
1995	imports	0.6	6.9	0.2	-	7.7
	exports	2.1	1.2	3.8	2.3	9.4
	imports-exports	*-1.5*	*5.7*	*-3.6*	*-2.3*	*-1.8*
1996	imports	8.6	4.1	2.1	1.0	15.8
	exports	0.3	7.9	1.4	0.1	9.6
	imports-exports	*8.3*	*-3.8*	*0.7*	*0.9*	*6.1*
1997	imports	5.2	3.6	0.9	0.4	10.2
	exports	0.9	6.8	4.3	0.8	12.8
	imports-exports	*4.3*	*-3.1*	*-3.4*	*-0.4*	*-2.6*
1998	imports	2.2	3.0	0.9	0.1	6.2
	exports	1.9	7.1	5.3	2.3	16.6
	imports-exports	*0.3*	*-4.1*	*-4.4*	*-2.2*	*-10.4*

Note: Rounding-off discrepancies occur. After deregulation of the electricity market, the Swedish interchanges are reported in the form of physical values per country, and they are therefore not entirely comparable with earlier years, when trade exchanges were reported. Being drawn from different sources, the figures in this table do not entirely agree with the figures reported earlier.

Source: Processed information from Statistics Sweden (SCB) and from the Swedish Power Association.



In the past, trade between Sweden and Finland was handled via Vattenfall and Imatran Voiman Oy. Svenska Kraftnät now owns 50% of the shares in EL-EX, together with FINGRID, the Finnish grid utility.

In the past two years, the number of players and the volume traded via NordPool have increased substantially. The number of players on the joint Swedish-Norwegian exchange was 258 at the end of December 1998, compared to 199 at the end of 1997. The number of Swedish players increased from 22 in 1996 to 43 in 1997. During 1998, the increase in the number of Swedish players tapered off and they totalled 45 at the end of December. The players include power generation utilities, distributors, industrial companies, dealers and traders. NordPool turns over electricity on the spot market (24-hour market) and forward market (weekly market). The spot market handles contracts for delivery during the next 24-hour period. The forward market is a financial market and handles contracts with a time horizon of up to three years.

The volume of trade on the spot market increased during both 1997 and 1998. In 1998, the physical market turnover was 56.3 TWh of electricity, which represents an increase of 29% on 1997. Trade on the forward market increased by more than 68% to 89.1 TWh. Moreover, 352.2 TWh were cleared in bilateral contracts. Clearing of bilateral contracts involves NordPool acting as the opposite party to sellers and buyers in bilateral forward contracts. The companies thus eliminate the risk of one opposite party not being able to fulfil its contractual obligations. For this service, NordPool levies a clearing charge, and the companies must deposit a security sum in a blocked bank account, in order to cover the risk taken by the electricity exchange in acting as the opposite party.

In January 1998, the Finnish grid utility took over the Finnish electricity exchange and concluded an agreement with NordPool for coordinating trade on the exchange and for opening an office in Finland. This was conditional on Finland forming its own price area and spot trading between the countries being pursued without border tariffs.

Since the 1997/98 turn of the year, Denmark is also a partner in NordPool, and discussions are in progress that could enable Danish power to be purchased on the NordPool exchange.

Sweden's electricity trade with neighbouring countries

The changes on the electricity markets in the four Nordic countries have given the players on the market access to the electricity network, and customers can choose their suppliers freely, basically even abroad. Swedish generators can thus sell electricity directly to customers in Denmark, Norway or Finland, and Swedish customers can purchase electricity in Denmark, Norway and Finland.

Several Swedish electricity generators now have agreements with generation utilities in neighbouring countries concerning imports and exports of electricity on long-term contracts. Long-term agreements with customers in other countries are also becoming increasingly common. Several of the newly formed Swedish electricity trading companies purchase electricity in Norway and Finland.

Trade between countries varies from year to year in terms of both scope and direction. Fluctuations in the business climate affect the need for electricity, and business conditions are not always the same in different countries. Trade in electricity can balance temporary national shortfalls and surpluses of electricity. The trade flows are affected by the availability of water in the Norwegian and Swedish systems. Figures 8, 9 and 10 show how trade flows have changed during 1997 and 1998.

During wet years, Sweden is a net exporter of electricity. During dry years, trade flows can reverse, so that Sweden and Norway become net importers of electricity, principally from Denmark, and the Danish power system thus serves as reserve capacity in the Nordic electricity generation system.

1996 was a distinctly dry year, and Sweden imported large amounts of electricity, principally from Denmark. The supply of water increased during 1997, and water levels in the Norwegian and Swedish water reservoirs reverted to their normal values, thus also affecting the scope and pattern of trade in electricity.

Imports of electricity during 1997 amounted to 10.2 TWh. Most of the electricity was imported from Denmark, which supplied 5.2 TWh, and from Norway, 3.6 TWh. During 1998, Sweden's total imports dropped to 6.2 TWh, of which 2.2 TWh came from Denmark and 3 TWh from Norway. Early in 1998, the import of electricity from Denmark was high, since the water reservoirs were still not adequately filled, however, during the second half of the year electricity was imported mainly from Norway, since the availability of inexpensive electricity from hydro power was good.

Total exports of electricity to neighbouring countries during 1998 amounted to 16.6 TWh, which represents an increase of 3.8 TWh from 1997. Exports to all neighbouring countries increased, and most of the exports went to Finland and Norway. As shown in Table 10, net Swedish exports in 1998 amounted to 10.4 TWh, which is the highest value ever recorded. ■

Figure 8 • Electricity imported by Sweden in 1997 and 1998, GWh per week

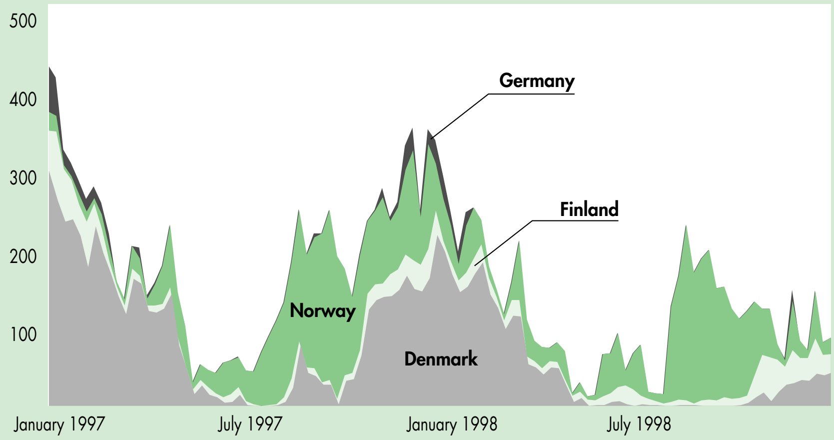


Figure 9 • Electricity exported by Sweden in 1997 and 1998, GWh per week

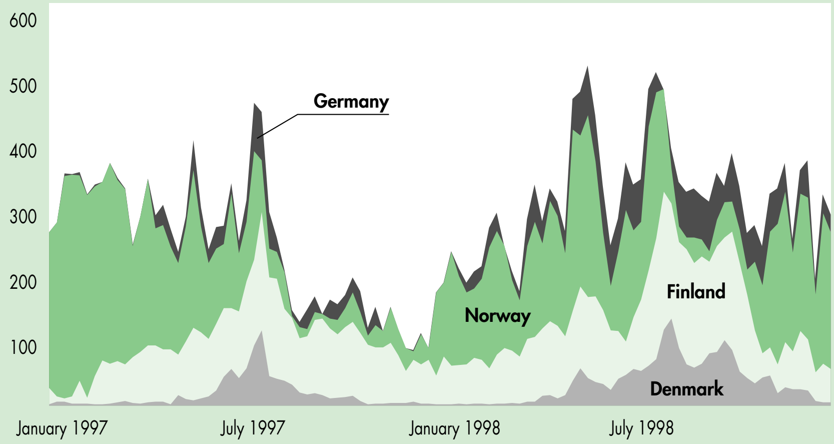
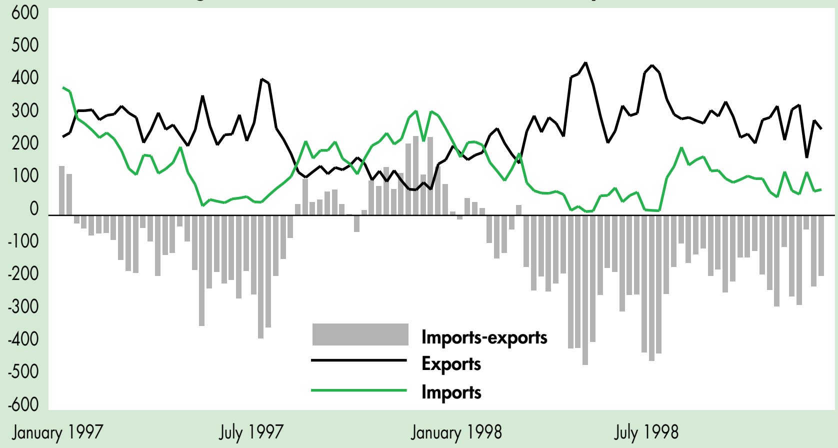


Figure 10 • Sweden's electricity trade with foreign countries in 1997 and 1998, GWh per week



Source: Compiled information from the Swedish Power Association.

Existing generation system

Variable electricity generation costs in the existing system consist of fuel costs and also operating and maintenance costs. The variable generation costs for various types of power are shown in Figure 11. The costs are calculated as the average per type of power.

For *hydro power stations*, average variable costs, including taxes, for all plants are around 4 öre per kWh. The costs may vary between just over 1 öre and 7 öre per kWh. On average, the tax amounts to 3.6 öre per kWh.

The variable generation costs of *wind power* are somewhere between 4 and 6 öre per kWh, depending on the wind conditions.

In the case of *nuclear power*, average variable generation costs are estimated at just over 7 öre per kWh, including taxes and nuclear waste charge.

Turning to *combined heat and power in industry*, the pulp and paper industry and the sawmills, for example, have access to fuel which is basically free of charge, since residual products occurring in the production processes in the form of liquors, bark, etc. can be used as fuel. Plants in industry also use fossil fuels. The variable generation costs fluctuate with fuel costs, which are lower for biofuels and higher for oil.

The variable generation costs for *combined heat and power in district heating* systems vary with the fuel used. The lowest costs are for coal-based generation, followed by oil, and with biofuels incurring the highest generation costs.

The variable generation costs in oil-fired condensing power stations vary between 20 and 30 öre per kWh if heavy fuel oil is used. If light fuel oil is used, the costs rise to between 30 and 40 öre per kWh. Light fuel oil is used in gas turbines, which results in a high variable generation cost.

New power generation plants

Total electricity generation costs for new power generation plant consist of variable costs, capital costs and other fixed costs. The costs shown in Figure 12 should be interpreted and used with caution, since every plant is unique, and local conditions are of major importance to the total costs. This applies particularly to the costs of condensing plants, since no such plants have been built in Sweden in the past 25 years.

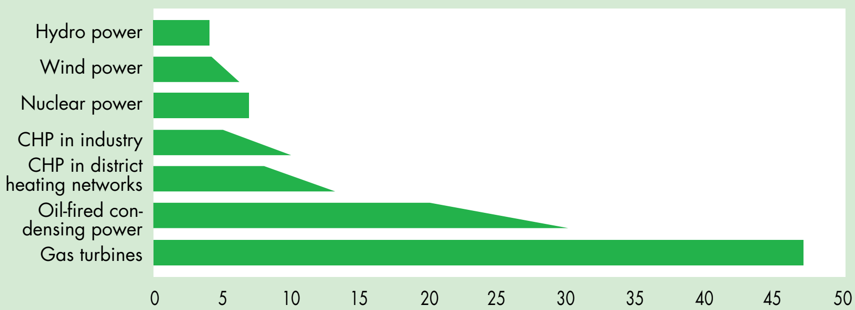
In a large-scale construction of *hydro power plant*, such as along a new stretch of river, the generation cost is around 25 öre per kWh. For individual large hydro power stations, the upper cost is estimated to be around 35 öre per kWh.

A new investment grant for wind power plants with an electrical output in excess of 200 kW was introduced on 1 July 1997. The new investment grant amounts to 15% of the investment cost, as opposed to the earlier grant which at times amounted to 35% of the investment cost. The total investment cost varies depending on the wind energy availability on each individual site. Total average cost amounts to between 28 and 33 öre per kWh without the grant, and between 24 and 28 öre with the grant. In addition to the investment grant, an operating grant of 15.1 öre per kWh is also allowed. The operating grant corresponds to the electricity tax applicable to households in southern Sweden.

The generation costs for *oil-fired condensing plants*, *natural gas combined cycle plants* and *coal-fired condensing plants* vary with the sizes of the various plants. For *wood-chip fired condensing power*, the plants are assumed to be small, i.e. of the order of 50 MW. The large volume of fuel needed and its handling restrict the plant size, and the generation cost will therefore be higher. The cost differences in wood-chip fired condensing power plants are also related to the costs of different techniques.

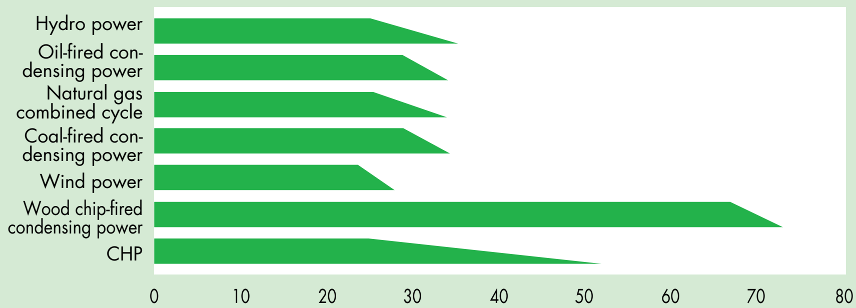
The costs of heat generation reduce the electricity generation costs in *combined heat and power plants*, which is known as heat crediting. Crediting is calculated on fuel crediting and on power crediting. The generation costs in combined heat and power plants vary widely. The wide scatter is due to the sizes of the plants, the fuel used and the crediting selected.

Figure 11 • Variable generation costs in existing electricity generating systems, öre per kWh



Source: Processed information from Sydkraft, the Swedish Power Association and Vattenfall.

Figure 12 • Total electricity generation costs in new plants, öre per kWh



Source: Summary and processed information from sources such as Kraftsam, Sydkraft and Steam Users' Association.

Electricity prices

It is important to distinguish between the concepts of network and electricity costs on the new electricity market. The total price of electricity to the customer consists of:

- price of electricity
- network tariff - price of the network service, i.e. for the transmission of electricity
- charges and taxes

The *network tariff* is designed as a "spot tariff". This means that the network tariff to consumers and generators is independent of the one with whom they trade in electricity. However, the network charge varies depending on whether the electricity consumer or the electricity generator is connected to the national grid, the regional network or the local network. An electricity consumer thus pays the same network charge regardless of whether the electricity has been purchased from a neighbouring or remote electricity supplier. Electricity generators also pay the same network charges regardless of the one to whom electricity is sold. The spot tariff also means that only one network charge is paid for gaining access to the entire transmission system. For customers who receive electricity from a local network, the regional and grid charges are included. The network charges are published, and are monitored by the National Energy Administration.

The thought behind the new electricity market is that *electricity should be purchased in competition*. When the network charge has been paid, the customer can basically trade freely on the network and choose the supplier offering the lowest price. The market price is therefore determined by supply and demand.

The changed rules for trading in electricity have created a number of procurement forms. However, the predominant part of electricity, estimated at around 80%, is still traded by long-term *bilateral agreements*, such as between a generator and an electricity supplier, between a generator and an industrial customer, or between an electricity trader and a company. Several different contract forms are used. In each individual case, the price depends on how successful the parties are in their negotiations, and on the make-up of the contracts. The prices are not published.

Most domestic customers still purchase electricity from the supplier who has a delivery concession. This gives the customer the right to have the reasonableness of the electricity price appraised.

Spot and forward markets

An *electricity exchange* is an organized marketplace for trading in electricity. The benefit of trading on the exchange is that transaction costs are lower than for bilateral agreements, since customers need not contact several suppliers and negotiate with them, and that suppliers need not call on various customers.

On the exchange, electricity is traded on the spot market and the forward market, i.e. 24-hour market and weekly market respectively. The spot market is a price reference for the NordPool forward market and the remainder of the electricity market.

The *spot market* is the Nordic market for physical deliveries of electric power. On this market, the players trade in hourly contracts for delivery in the next 24-hour period. Before 1200 hours, the players send in their bids for all hours of the next 24-hour period. The buyers state how much electricity they want to purchase, hour by hour, and what they are prepared to pay for it. The sellers submit corresponding selling bids. The collective bids of the players are compiled into an supply curve (sales) and a demand curve (purchase). The price is determined as an equilibrium price at the point of intersection of the supply and demand curves.

In the event of network limitations, known as bottlenecks, the bidders must specify the part of the system in which electricity is to be purchased or sold, which is known as the notification area. The whole of Sweden is one notification area, since bottlenecks within Sweden are handled by means of so-called counter-purchases. Norway has several notification areas, since bottlenecks are handled by price areas and capacity charges. The price mechanism is used for regulating the power flow in situations in which there are capacity limitations in the network. The spot market can therefore be regarded as a combined energy and capacity market.

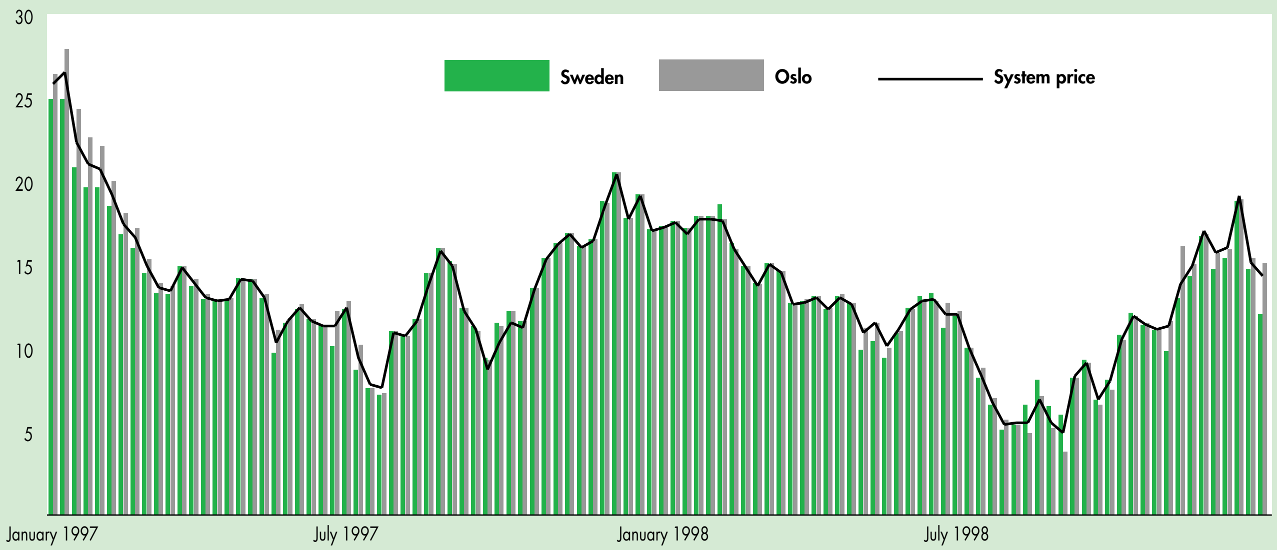
There are different prices depending on the pattern of power flow. A system price is calculated, provided that there are no transmission limitations in the network. If price calculations show that the power flow between two or more notification areas exceed the capacity limit, two or more area prices will be calculated. The difference between the system and area prices is the capacity price in each area. If the capacity between the notification areas is not exceeded, there will be only one price area. In this case, the area price will be equal to the system price, and the capacity price will be zero.

The *forward market* is a purely financial market and represents an organized market for price assurance and risk handling. The players on the forward market can use financial contracts to assure the prices of purchases and sales of power up to three years ahead in time. The result for the buyer will be a gain or loss on the price difference between the price on the exchange at the delivery date and the price at the purchase date. The system price on the spot market serves as an underlying reference for forward prices.

Lower exchange prices

The price of electricity on the exchange reflects the balance between supply and demand. As a result of a mild weather in the beginning of 1997 and a relatively good supply of water, the exchange price was much lower than in the previous year. In the spring of 1997, the electricity prices were below 20 öre per kWh. This is not unusual during the summer half of the year, but the price level remained low throughout the year. In 1997, the average system price on the exchange was 14.6 öre/kWh. In 1998, the prices began at a lower level than in 1997, and then continued to decline as a result of increased water in- →

Figure 13 • System price on the 24-hour market and prices for the Sweden and Oslo areas during 1997 and 1998, öre per kWh



Source: Processed information from NordPool, ASA.

flow into the water reservoirs. During the summer months, exchange prices reached record low values; the lowest weekly average price was recorded at 5,0 öre/kWh. The average price in 1998 was 12.3 öre/kWh, which is below the 1997 price, in spite of the fact that 1997 was characterized by low exchange prices. An interesting factor is that average weekly prices on the exchange did not exceed 20 öre/kWh at any time during 1998.

Due to physical limitations in the transmission capacity between Sweden and Norway, two different prices have periodically emerged on the spot market in the two countries, i.e. a capacity charge arose. In the beginning of 1997, when a large amount of electricity was transmitted from Sweden to Norway, the electricity prices in Sweden were somewhat lower than in Norway. During the second half of 1997, the prices usually coincided with the system price. In 1998, the prices in Norway and Sweden agreed fairly well, except during a few weeks. The average price was somewhat lower in Sweden than in Norway.

Total price of electricity

The prices on the exchange should not be compared with the prices specified for private customers on their electricity bills. In addition to the exchange price, the latter also include other items, i.e. the network tariff, charges and taxes, and also the trading markups of the electricity trading companies.

Table 11 shows the total price of electricity sold under a delivery concession to different customer types.

The total price charged to customers in apartments rose up to 1 January 1998 by an average of 6.9%, face value, compared to 1 January 1997, as shown in Table 12. For customers in single-family dwellings without electric heating, the total price increased by 5.8%, and for customers with electric heating, by an average of 4.2%.

Network tariffs and electricity price

A focal point of departure for the electricity market is that all customers must have the right to free choice of supplier. Hourly metering of electricity consumption is required for this purpose, which presupposes that the consumer has a meter that can take hourly readings. In order to increase the mobility on the electricity market, a ceiling price of SEK 2500 has been set for the installation of a meter. At the end of 1998, the Riksdag decided to revoke the hourly metering requirement. The decision will come into force on 1 November 1999.

The legislation specifies that every area shall have one supplier - a delivery concessionaire - who is responsible for supplying electricity to all customers. The consumer is thus guaranteed a supply of electricity at a price which may be appraised by the National Energy Administration. After giving appropriate notice, the consumer has the right to change his supplier and to buy electricity from a supplier other than the one who has the delivery concession for the area.

The Electricity Act specifies that the customer shall receive separate prices for the network service and for electricity. According to the Electricity Act, the network charge, i.e. the price of the network service, shall be reasonable and impartial. This implies that the level of charges levied by the companies should produce a reasonable return on the capital invested, and no profits beyond that. Impartiality means that the charges shall be cost-related, which means that every customer category must bear its own costs. The network charges must also be non-discriminatory within a given customer category. Cost-related charges also mean that the structure of the charge in terms of various components must be cost-related, e.g. divided into fixed and variable elements.

The network charge consists of a fixed part linked to the power demand that the subscription makes, and a variable part intended to cover the network losses that arise. In the cost structure of the network utilities, the variable costs that arise in the transmission of electricity correspond to around 10 - 15% of total costs. For domestic customers, the distribution between fixed and variable charges varies. For apartments, the fixed part averages 68%, whereas for single-family dwellings with electric heating, it is 48%.

The network charges and electricity prices in 1998 for different customer types are summarized in Table 13. There is appreciable scatter between the companies. To a certain extent, the scatter is explained by customer density differences between the companies. Tables 14a and b show the median values for four different customer density groups for apartments and single-family dwellings with electric heating for the period between 1997 and -98.

Table 11 • Total price of network service and electricity on 1 July 1998 for the sale of electricity under a delivery concession to different customer types, öre/kWh, incl. taxes[1]

	Mean value	Upper quartile	Median	Lower quartile
Apartment	106.8	114.8	107.0	97.9
Single-family dwelling without electric heating	97.8	104.1	97.6	89.7
Single-family dwelling with electric heating	75.2	79.2	75.0	71.3
Agriculture or forestry	75.2	79.7	74.6	70.6
Small industrial plant	38.1	41.1	38.8	35.8
Medium-sized industrial plant	-	-	-	-
Electricity-intensive industrial plant	-	-	-	-

[1] Industrial customers pay no tax.
- not available.
Source: *Priser på elenergi och nättjänst 1998 (Prices of electricity and network service in 1998)*, E 17 SM 9801, Statistics Sweden (SCB).

Table 12 • Total average prices of electricity, including taxes, öre per kWh

	1995	1/1 1996	1/1 1997	1/1 1998
Apartment	90.2	97.6	99.9	106
Single-family dwelling without electric heating	82.7	90.0	92.4	97
Single-family dwelling with electric heating	64.0	67.5	72.2	74

Source: Statistics Sweden (SCB).

Apartment	2 MWh/year, 16 A meter fuse rating
Single-family dwelling without electric heating	5 MWh/year, 16 A meter fuse rating
Single-family dwelling with electric heating	25 MWh/year, 20 A meter fuse rating
Agriculture or forestry	30 MWh/year, 35 A meter fuse rating
Small industrial plant	5 GWh/year, 1 MW power demand
Medium-sized industrial plant	140 GWh/year, 20 MW power demand
Electricity-intensive industrial plant	500 GWh/year, 66 MW power demand

The median is the value of the variable for the centre company when the companies are arranged in the order of magnitude of the variable. Half the companies have a value which is lower than the median and half have a value which is higher than the median. In a corresponding manner, 25% of the companies have a value which is lower than the *lower quartile*, and 25% have a value which is higher than the *upper quartile*.

Table 13 • Prices of network services and electricity, excluding taxes, on 1 January 1998 for different customer types, öre per kWh

	Mean value		Upper quartile		Median		Lower quartile	
	network	electricity	network	electricity	network	electricity	network	electricity
Apartment	42.3	29.0	48.1	31.8	42.8	28.8	34.9	26.2
Single-family dwelling without electric heating	37.1	26.8	43.4	28.4	36.9	27.1	30.9	26.0
Single-family dwelling with electric heating	20.7	25.1	23.4	26.3	20.5	25.3	17.9	24.5
Agriculture or forestry	21.7	24.1	24.6	25.6	21.4	24.0	18.5	23.0
Small industrial plant	14.8	24.1	17.3	24.8	14.8	24.5	12.7	22.6
Medium-sized industrial plant		23.1		25.1		23.4		21.0
Electricity-intensive industrial plant		22.7		23.1		22.7		20.9

Source: *Priser på elenergi och nättjänst 1998 (Prices of electricity and network service in 1998)*, E 17 SM 9801, Statistics Sweden (SCB).

The median of the network charges for customers in apartments increased from SEK 822 to SEK 847 per customer, which represents an increase of 3% between 1997 and 1998. If network charges are weighted with regard to company size, measured as the number of customers, the increase will be 3.2%. For a customer living in an apartment in a built-up area in which the customer density is less than 60 metres, the network charge increased from SEK 640 to SEK 664 per customer, which is an increase of less than 4% in the same period.

The network charge median for a single-family dwelling with electric heating was SEK 4078 per customer in 1998, which is a drop of 4.1% on 1997. If the charges are weighted with regard to the size of the companies measured in terms of the number of customers, the drop would be 3.1%. The development of the network charges displays a change in the relative price in favour of customers who draw more power, which is reflected by the network charges for customers in apartments having increased, while the network charges for single-family dwellings with electric heating have decreased.

The network charge for apartments has increased in real terms by 3.3% between 1997 and 1998. For single-family dwellings without electric heating, the charge has increased in real terms by 2.1%, whereas the charge for single-family dwellings with electric heating has decreased in real terms by 5.2%. The weighted total of the network charges for the three household types has dropped in real terms by 0.8% during 1997[1].

In the publication giving *general advice on network charges* published by the then Network Administration at NUTEK in the autumn of 1997 (NUTFS 1997:1), the local network companies were advised to lower the network revenues by 2.4% during 1998. The recommendation has been met for single-family dwellings with electric heating, but the network charge for the other customer categories has not reached the level of this recommendation. For households as a group, the charges have dropped by 0.4%, which is much lower than the value recommended by the then Network Administration at NUTEK.

The monitoring by the National Energy Administration of the network companies is aimed at ensuring that these companies will run their operations in such a manner that the interest of the customers in cost-efficiency and reliability of supply will be met. The National Energy Administration must also endeavour to ensure that the network charges and electricity prices within a delivery concession are reasonable and objectively drawn up.

Taxation system

Electrical energy is taxed at both the consumer level and the generation level. Certain customer categories also pay VAT, Value Added Tax.

Consumer level. A tax is levied when electricity is used. For most users, the electricity tax from 1 January 1999 is payable at the rate 15.1 öre per kWh. Since 1993, the manufacturing industry, mining and the greenhouse industry are exempt from this tax. Certain municipalities in northern Sweden have a lower tax, which today amounts to 9.5 öre per kWh. The use of electricity in electric power, gas, heat and water supplies is also subject to a lower tax rate at 12.8 öre per kWh. Since November 1998, tax has been levied during the winter half of the year (1/11 - 31/3) for electricity consumption in electric boiler plants with an installed rating in excess of 2 MW. The tax rate is 11.8 öre per kWh in northern Sweden and 15.1 öre per kWh in the remain- →

Table 14a • Network charges for customers living in apartments in 1997 and 1998, SEK per customer

	Customer density[1]	1997	1998
Urban area	- 60	640	664
Mixed housing	60–90	818	821
Rural area	90–125	823	849
Sparsely-populated area	125 -	926	936

Table 14b • Network charges for customers living in single-family dwellings with electric heating in 1997 and 1998, SEK per customer

	Customer density*	1997	1998
Urban area	- 60	3 750	3 585
Mixed housing	60–90	4 260	4 052
Rural area	90–125	4 350	4 152
Sparsely-populated area	125-	4 707	4 573

* Metres per customer

Note: The network charge is a median value.

Source: *Utvecklingen på elmarknaden 1998 (Developments on the electricity market 1998)*, ER 29:1998, National Energy Administration.

[1] The weighting is based on the Statistics Sweden (SCB) distribution of customers onto different housing forms (E11 SM 9603) for 1995.

The weighting has been done with regard to the distribution of fixed and variable charges, and on the basis of the number of customers and the electricity volumes for the three customer type categories. The weighting is 33% for an apartment, 25% for a single-family dwelling without electric heating, and 42% for a single-family dwelling with electric heating.

Table 15 • Electricity taxes at consumer level, öre per kWh

	1995	1996 1 Jan.	1996 1 Sep.	1997 1 Jan.	1997 1 Jul.	1998 1 Jan.	1999 1 Jan.
Northern Sweden							
district heating utilities	3.7	4.3	5.3	7.4	8.2	9.6	9.5
industrial operations	0	0	0	0	0	0	0
other users	3.7	4.3	5.3	7.4	8.2	9.6	9.5
Remainder of Sweden							
district heating utilities	6.8	7.5	9.1	10.7	11.5	12.9	12.8
industrial operations	0	0	0	0	0	0	0
other users	9.0	9.7	11.3	13.0	13.8	15.2	15.1

Source: Special tax office in Ludvika, Taxation authority in Gävle.

Table 16 • Generation taxes on hydro and nuclear power, öre per kWh

	1995	1996 1 Jan.	1996 1 Sep.	1997 1 Jan.	1998 1 Jan.	1999 1 Jan.
Hydro power plants						
up to 1972	2.0	4.0	5.0	0	0	0
1973 - 1977	1.0	2.0	2.5	0	0	0
1978 onwards	0	0	0	0	0	0
property tax				3.9	2.5	1
Nuclear power	0.2	1.2	2.2	2.2	2.2	2.2

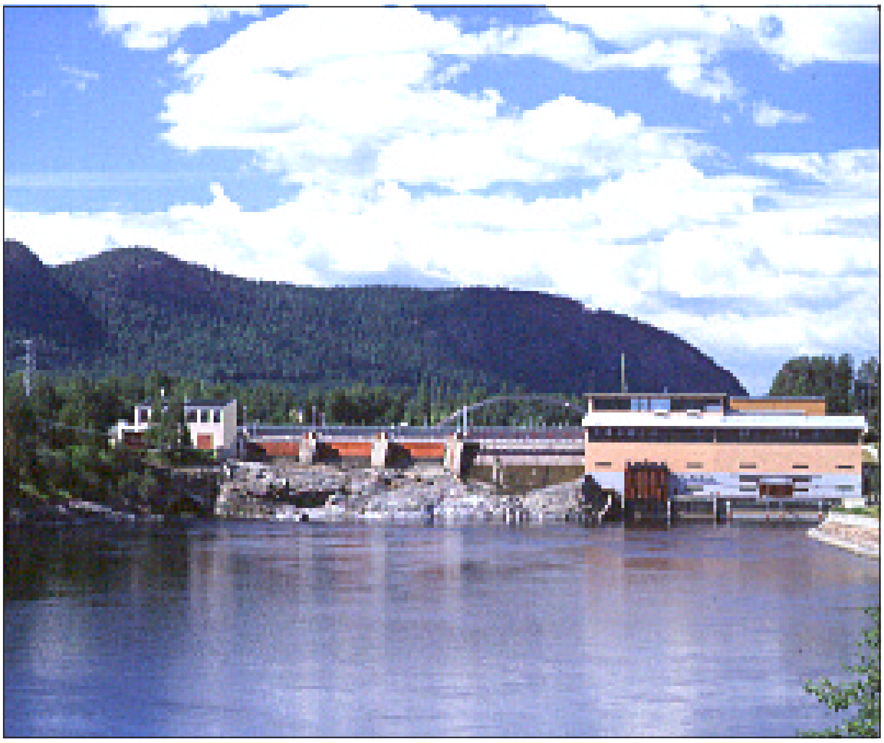
Note: The years indicate when the plants were taken into operation.
Source: Swedish Power Association.

der of Sweden. Since 1994, the electricity tax has been adjusted annually in line with the consumer price index. VAT on electricity amounts to 25% and is charged on the price of electricity, including energy tax.

Generation level. All fuels used in Sweden for electricity generation are now exempt from energy and carbon dioxide taxes. However, a certain proportion of the fuel is assumed to be used for in-house consumption, i.e. 5% in condensing and gas turbine generation and, in CHP generation, 3% of the fuel used for electricity generation, and this proportion is taxed. On the other hand, all fuels for electricity generation are subject to nitrogen oxide charges and, where applicable, sulphur tax. The sulphur tax on coal and peat amounts to SEK 30 per kg of sulphur emission. The sulphur tax for oil is SEK 27 per cubic metre for every tenth of one percent by weight of sulphur content in the oil. Fuels used for heat generation in combined heat and power stations are subject to half the energy tax, and also to carbon dioxide and sulphur taxes.

Nitrogen oxide emissions are subject to an environmental charge amounting to SEK 40 per kg of nitrogen oxides from boilers, gas turbines and stationary combustion plants. The nitrogen oxide charge is levied on plants with an annual energy generation output of at least 25 GWh. The charge is neutral to state finances. The funds collected are returned to plants that have the lowest emissions in relation to their own energy generation, whereas plants with the highest emissions are net contributors.

Electricity generation in nuclear power stations is subject to tax at the rate of 2.2 öre per kWh. In addition, 0.15 öre per kWh is levied in accordance with the "Studsvik Act", and an average of 1.2 öre per kWh in accordance with the law on financing future expenditure for spent nuclear fuel. From 1 January 1996, electricity generation plants have been paying a property tax amounting to 0.5% of their taxable value. The table shows that hydro power plants had earlier been subject to a special property tax. This no longer applies. ■



Electricity from the power stations is transmitted to the consumers by a network of power lines. The network is normally classified into three levels, i.e. the national grid, regional networks and local networks. The Svenska Kraftnät authority is responsible for operating, managing and developing the power transmission system, which consists of around 16 000 km of 220 kV and 400 kV lines with stations, and for most of the links with the neighbouring Nordic countries.

Power generators, distributors and electricity consumers can use the national grid for transmitting electricity from their own generation plants, or purchased electricity, to those parts of the country where electricity is used or sold to neighbouring countries. In 1998, around 35 companies concluded utilization agreements with the Svenska Kraftnät authority. Around one third of these companies are regional network owners and the remainder are power stations.

Charges on the national grid

A new charging system was introduced on 1 January 1995, whereby the charges are determined per connection point. The charge consists of four elements, i.e. power charge, special power charge, energy charge and investment contribution.

For the charge to reflect actual costs, it must vary depending on energy and power conditions at the connection point, and on geographical location. The latter is explained by the fact that electricity is transmitted on the grid mainly from the hydro power stations in northern Sweden to the consumption areas in central and southern Sweden. In northern Sweden, the input of electricity into the grid causes the load on the grid to increase, whereas output causes the load to decrease. The reverse applies in southern Sweden.

The power charge depends on the geographical location of the connection point and differs for input and output at a given point. An input point in the north is subject to a higher power charge than an input point in the south. The reverse applies to output points. In 1998, the charge varied between SEK 2 and SEK 38 per kW.

From 1 January 1998, a special power charge is levied for meeting the costs incurred by Svenska Kraftnät for maintaining a disturbance reserve. The charge is levied on thermal power units on the part of the net output exceeding 350 MW.

The energy charge is calculated as the product of the loss coefficient, energy price and energy input or output. Every point in the network is assigned a definite loss coefficient that corresponds to the calculated change in energy losses as an incremental change in the energy exchange caused at the point under normal operating conditions. A positive coefficient leads to debiting of the input of electricity and crediting of the output. The reverse applies to a negative coefficient. The energy price is determined in advance, one year at a time, and is based on the purchase price paid by the Svenska Kraftnät authority to its energy suppliers for covering the grid losses. The average price of energy in 1998 was 18 öre per kWh.

If connection of a new customer plant to the national grid incurs costs that are not met by the ordinary charges, Svenska Kraftnät can demand an investment contribution from the customer.

System responsibility and balancing service

The Balancing Service of Svenska Kraftnät bears short-term responsibility for maintaining the balance between electricity supply and demand in the country. From 1996, the Balancing Service has borne responsibility for maintaining the frequency and also for any bottlenecks that occur in the transmission of electricity on the grid.

Early in 1998, more than forty companies concluded balancing responsibility agreements with the Balancing Service. The agreement governs the handling of balancing power, i.e. the difference between the planned electricity supply and consumption of a company, and the actual utilization. Anyone who wants to trade in electricity in Sweden must have balancing responsibility arranged, either directly with Svenska Kraftnät or indirectly through one of the companies responsible for balancing.

In spite of agreements with those responsible for balancing, unbalance could nevertheless occur in the operating system for various reasons. These unbalances can be corrected by those responsible for balancing, primarily by trading on the spot market. After the electricity exchange has closed, the Balancing Service provides the last opportunity on the open market to adjust quickly, before the end of the operating hour, any unbalance that may have occurred. However, the transactions must have been concluded no later than two hours before the operating hour. If this has failed, the Balancing Service must act by regulation during the operating hour itself. From 1 March 1999, "Balancing adjustment" that gives companies the opportunity to adjust their balances two hours before the operating hour will be transferred to the Finnish EL-EX.

Frequency control

The Balancing Service employs primary and secondary regulation for handling unbalance during the operating hour itself. Primary regulation is used for fine adjustment of the physical balance. This takes place by a number of hydro power stations being automatically activated for raising or lowering the frequency. This power is purchased by the companies responsible for balancing that have offered this type of power interchange. According to a Nordic agreement, Sweden shall maintain a regulating capacity of 2500 MW per Hz for primary regulation.

Secondary regulation takes place manually on various regulating objects. No later than 30 minutes before the beginning of the operating hour, bids for secondary regulating power are submitted to the Balancing Service by suppliers who have the capacity to adjust their generation or consumption during the operating hour. The Balancing Service then places orders against such bids, as required, in price order.

The Balancing Service also ensures that sufficient reserves are available in the power system. These may consist, for example, of quick-starting gas turbines or oil-fired condensing power stations with much longer start-up times.

Charges for balancing service

Energy for power interchange by the Balancing Service is priced and settled with the company responsible for balancing. The charges

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vary depending on the services that the companies responsible for balancing utilize. Companies responsible for balancing that are not debited any of these charges must pay a minimum annual charge.

A fixed charge and a volume charge per purchased or sold MWh are charged for access to balance adjustment power, i.e. power purchased or sold before the operating hour. Those responsible for balancing pay a power charge and a volume charge for balancing power, i.e. adjustment during the operating hour.

No charges are made for balance regulation. Trade takes place against orders from the Balancing Service, which trades on the basis of the bids received.

The company responsible for balancing that reports bilateral transactions in accordance with a fixed power agreement that is to be settled pays an arrangement charge and then an annual charge per opposite party. Transactions with the NordPool spot market or with Svenska Kraftnät are not covered by this charge.

Transmission losses, cost developments and reliability

Certain energy losses always occur in the transmission of electricity. In the past, the losses were compensated by an extra input of electricity from the companies connected to the grid. From 1995, Svenska Kraftnät has been purchasing all of the energy needed for covering the energy losses on the national grid. The total annual losses are estimated to be between 2 and 3 TWh, and the cost is estimated to be between SEK 500 and SEK 700 million annually. The transmission losses vary with the power situation in the country. During years when a large proportion of the electricity is generated by hydro power, the transmission losses are higher due to the long distances to the consumers.

The transmission situation in 1997 shifted as a result of the way in which hydro power was utilized in Sweden and Norway. In the beginning of the year, Norway imported a substantial amount of power, much of which came from Denmark. This gave rise to high transmission rates northwards on the main grid on the west coast of Sweden. In a situation such as this, a serious disturbance occurred on New Year's day in 1997. An initial fault caused by icing of a transformer connection led to tripping of the heavily loaded main grid. This, in turn, caused two nuclear power units in Ringhals to trip, and around 200 MWh of consumption were shed. A total of nine of the disturbances led to supply interruption. The most important measure of reliable operation is "energy not delivered". In 1997, this amounted to 279 MWh.

The total transmission cost includes the costs of capital, operation and maintenance, administration, and the costs of transmission losses. A key factor that shows the cost development is the specific cost in öre per kWh, and this amounted to 1.70 öre per kWh in 1997. The corresponding figures in 1996 and 1995 were 1.55 and 1.53 öre per kWh respectively. The increase is due to the higher costs of the national grid losses which, in turn, are due to the increased transmission of hydro power from Norrland. The calculation does not include the costs associated with the system responsibility of Svenska Kraftnät, e.g. payments for disturbance reserve and purchases of regulating capacity, and neither do they include costs of a once-only nature.

Table 17 • Data for the national grid between 1995 and 1997

	1995	1996	1997
Subscribed power, MW			
input point	22 059	21 539	21 927
output point	23 227	22 672	22 745
Maximum power output, GW	19.1	19.0	18.8
Energy input, TWh	115.4	114.3	114.6
Energy output, TWh	113.1	112.2	112.1
Proportion of total supply, percent	75	75	72
Energy losses, TWh	2.3	2.1	2.5
proportion of energy output, percent	2.0	1.9	2.2
Maximum power losses, MW	635	660	610
proportion of maximum power output, percent	3.3	3.5	3.2
Transmission costs, öre per kWh	1.53	1.55	1.70
Number of disturbances per year	196	162	291
Number of disturbances with supply interruption	5	7	9
Energy not delivered, MWh per year	6	133	279
Average interruption time, seconds per year	2	37	78

Source: Compilation of information from the Annual Report of Svenska Kraftnät.

Links with foreign countries

The links for electricity trade between Sweden and other countries are shown in Table 18.

Svenska Kraftnät owns all links with Norway, Finland and Jutland. Svenska Kraftnät and Sydkraft own the links with Zealand. A separate company, owned jointly by Sydkraft, Vattenfall and the German company Preussen Elektra, own the Baltic Cable to Germany. Due to limitations on the German network, the capacity of the cable is not yet fully utilized.

In addition to the direct links to the Continent, Sweden now has two further links with Germany, i.e. the link via Jutland, and the Kontek link between Zealand and Germany.

Svenska Kraftnät sells transmission services to the links with the neighbouring Nordic countries. This service gives the customer the right to transmit power on the Swedish part of the foreign link, i.e. to or from the national border. The service also includes the right to feed power into or receive power from the Swedish national grid. For transmission on the other side of the national border, the customer or his trading partner in the neighbouring country must conclude a transmission right agreement with the relevant grid owner.

In the same way as the national grid charge, the charge for foreign trade is geographically differentiated in order to reflect loading on the grid. This means that import and export charges for a given country are different. No network charge is payable between Norway and Sweden for spot transactions on NordPool.

The charge consists of a subscription charge and an energy charge per MWh according to the actual electricity traded. A subscription gives the subscriber the right to utilize a link, and can be concluded in the form of an annual or hourly subscription. Annual subscriptions are intended for long-term power contracts, whereas hourly subscriptions are sold in 24-hour periods if capacity is available.

After Svenska Kraftnät has been notified of planned trade on an annual subscription between Sweden and Finland, the available capacity is made accessible principally for spot trading on NordPool. When spot trading has been completed in the afternoon, applications for hourly subscriptions may be processed.

Table 18 • Links with foreign countries

Country	Link	Import, power in MW	Export, power in MW
Norway	Southern Norway	1 800	1 650
	Middle Norway	500	500
	Northern Norway	300	300
	Northern Norway	1 350	1 350
Denmark: Zealand	Sweden-Zealand	1 800	1 600
Denmark: Jutland	Kontiskan 1	280	290
	Kontiskan 2	360	380
Finland	Northern links	900	1 400
	Fennoskan	515	515
Germany	Baltic Ring	452	372

Source: Svenska Kraftnät.

For imports of electricity from Norway, scope is available for concluding a "priority transmission subscription" agreement. These agreements are linked to Norwegian export quotas and comprise only a minor proportion of the trade, and will be discontinued during 1999.

All other electricity trading across the border takes place via the spot market. This can take place, for example, by a Norwegian generator selling electricity to NordPool in Norway, and a Swedish consumer buying the corresponding amount from NordPool in Sweden. No charge is levied for such electricity trading.

SwePol Link

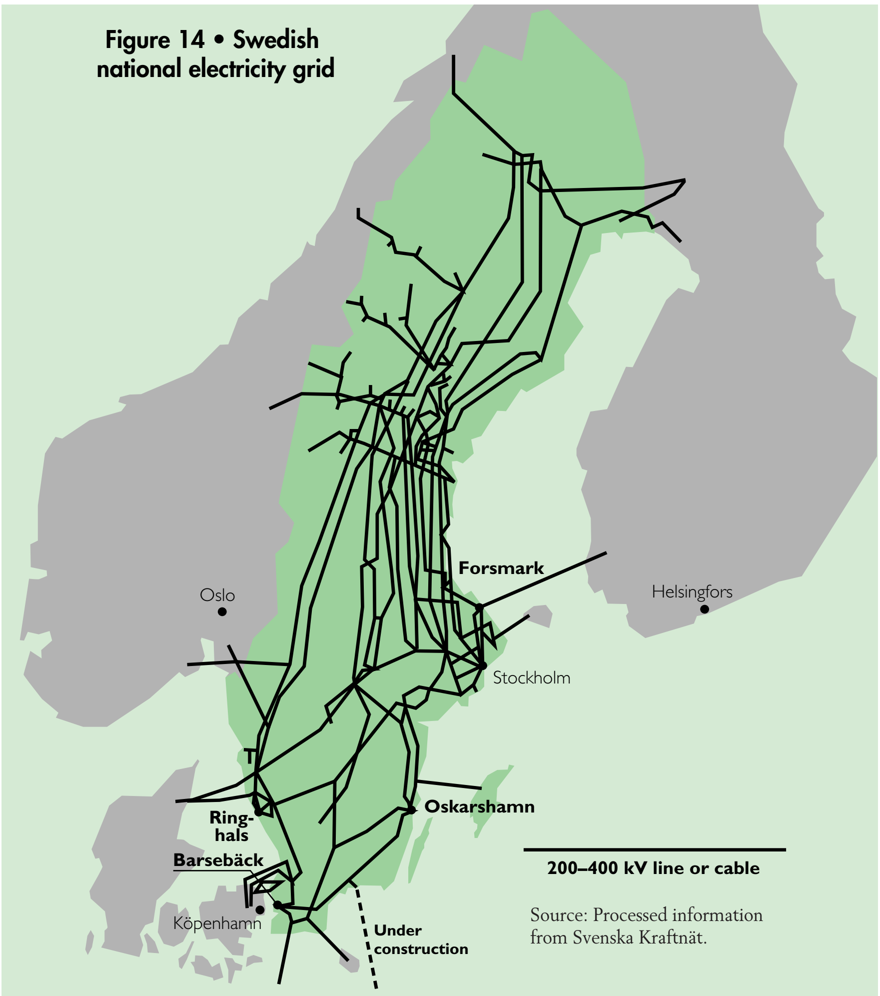
A widely discussed project is the electric cable being planned to link Sweden with Poland. The link, which is known as the SwePol Link, was designed as a high-voltage DC cable with a capacity of 600 - 800 MW and was expected to be ready for commercial operation in 1999. The cable will be financed and owned by a joint venture company in which Svenska Kraftnät will own 51%, Vattenfall 48% and the Polish Grid Company 1%. The Swedish Government has granted a concession, but the project has met opposition both in Sweden and in Poland. This has resulted in the planned connection point in Poland being moved. The cable is expected to be in operation at the 1999/2000 turn of the year.

Regional and local networks

The regional networks normally operating at voltages of 70 - 130 kV and, in certain cases, 220 kV link the national grid with major electricity recipients. These are mainly network utilities with local networks, and also certain major industrial consumers. The regional networks are owned and operated by power utilities. Vattenfall owns about 50% of the country's regional networks. A voltage-related spot tariff is used for the regional networks, which means that the price varies with the level of voltage to which the customer is connected.

The local networks, which normally operate at a maximum of 20 kV, are owned by the network utilities. Within the distribution areas, the voltage is stepped down to normal domestic voltage of 380/220 volt. In conjunction with the change-over to separate network tariffs and electricity prices, many companies have chosen to charge a relatively high proportion of the network tariff as a fixed charge. Certain companies employ only a fixed charge for the network service, although some companies have a high variable charge proportion. Companies that have a high proportion of variable network tariff do this for competitive reasons and consider that such tariffs make it of greater interest for the customer to improve energy efficiency. ■

Figure 14 • Swedish national electricity grid



Source: Processed information from Svenska Kraftnät.

During 1997, the seven biggest power utilities in Sweden accounted for around 133 TWh or 92% of total electricity generated in Sweden. The two largest Swedish power generators, i.e. Vattenfall and Sydkraft, jointly accounted for just over 70% of total electricity generated in the country. See Table 19.

Vattenfall AB
Vattenfall generates and delivers around half the total electricity consumed in Sweden. With 900 000 customers, the company is the biggest electricity generator in the Nordic countries and is the sixth largest in Europe. Generation is based mainly on hydro and nuclear power. During 1997, hydro power generation accounted for 36 TWh. The Ringhals and Forsmark nuclear power plants produced 43 TWh. In addition, other thermal power delivered 0.1 TWh, and wind power, 0.02 TWh.
The electricity generated by Vattenfall in 1997, including minority shares and contracted-out power, amounted to 79.1 TWh. In-house generation was supplemented by purchases from other suppliers by means of agreements or through the NordPool and EL-EX electricity exchanges. The electricity purchased by Vattenfall during 1997 amounted to 10.7 TWh.

Out of total Vattenfall electricity sales of 78.7 TWh, around 94% were contracted deliveries. The company's Swedish market still dominates, but sales in Finland and Norway are growing. Outside the Nordic countries, Vattenfall also has operations in Germany, the Czech Republic, the Baltic States, Poland, South-East Asia and South America.

Sydkraft AB
Sydkraft is the second largest Swedish electricity generation utility. The total electricity generated in 1997, including minority shares and contracted-out power, amounted to 28.7 TWh. Hydro power accounted for 10.5 TWh of the energy generated. Nuclear power generation in Barsebäck and Oskarshamn totalled 17.2 TWh. The fossil-based energy generation took place in the oil-fired and gas-fired Heleneholm and Karlshamn power stations, which produced 0.2 TWh of electricity during the year. The Örebro and Malmö combined heat and power stations generated 0.8 TWh of electricity. The wind power plants in Landskrona delivered 14 GWh. The energy generated during 1998 rose to 30.9 TWh, mainly due to the higher hydro power production.

During 1997, Sydkraft purchased 1.9 TWh of electricity on the exchange. The physical electricity sales in 1997 amounted to 32 TWh, of which 2.7 TWh were sold via the electricity exchange. Electricity sales rose to around 33 TWh during 1998.

Stockholm Energi AB
Stockholm Energi generates electricity in hydro power stations and in the Oskarshamn and Forsmark nuclear power plants. During 1997, hydro power accounted for 4.8 TWh and nuclear power for 4.9 TWh. Stockholm Energi also owns fossil-fired and biofuel-fired combined heat and power plants that produced 0.9 TWh of electricity during the year. The total electricity generated amounted to 10.6 TWh, including minority shares and contracted-out power.

During 1997, the company purchased 1.7 TWh of electricity. Out of the total of 11.6 TWh of electricity sold by Stockholm Energi, 89% consisted of contracted deliveries.

Gullspångs Kraft
Gullspångs Kraft generates most of its electricity in its own hydro and nuclear power stations. During 1997, hydro power generation amounted to 5.4 TWh. Through shares in Forsmark and Oskarshamn, nuclear power accounted for 5.3 TWh. Out of the total of 14.7 TWh of electricity sold by Gullspång, 82% consisted of contracted deliveries.

Stora Kraft
Stora Kraft is a member of the STORA Group, which is one of Europe's biggest forestry conglomerates. During 1997, the electricity consumption of the group in Sweden amounted to around 7.8 TWh, of which around 2 TWh was generated in the company's own industrial CHP plants. Stora Kraft also generates electricity in hydro, thermal and nuclear power plants. Hydro power generation during the year amounted to 3.9 TWh. The electricity generated in nuclear power plants through shares in Oskarshamn and Forsmark amounted to 2.1 TWh.

The total energy generated was 6.1 TWh and electricity purchases were around 1.4 TWh. The energy generated by hydro and nuclear power in 1998 increased to around 6.6 TWh. Total electricity deliveries in 1997 amounted to 7.5 TWh.

Graninge
The entire generation system of the company is based on hydro power. During 1997, energy generated in the company's own hydro power stations amounted to 2.5 TWh. Electricity purchased totalled 2 TWh, of which 1.3 TWh was purchased on the electricity exchange. Out of total electricity of 4.5 TWh purchased by Graninge, 78% were contracted purchases.

Skellefteå Kraft
The power generation system of the company is based principally on hydro power. The company also has minor holdings in Forsmark. Total electricity generated in 1997 was 2.6 TWh. Hydro power accounted for 2.1 TWh and nuclear power for 0.5 TWh.

Electricity purchases in 1997 amounted to 0.3 TWh. Total electricity sales were 2.8 TWh. Electricity sales during 1998 rose to about 3.2 TWh, and electricity generation increased to 3.1 TWh.

Structural changes

1998 was the third year of reformed electricity markets in Sweden and Finland. Norway deregulated its electricity market back in 1991. Increased competition on the electricity market, good availability of electricity and low exchange prices were characteristic features of 1998. The ownership conditions have changed since deregulation, above all on the Swedish market but also on the Nordic electricity market. Strategic investments were made by the major power utilities. Vattenfall in Sweden, Statkraft in Norway, Imatran Voima in Finland and PreussenElektra in Ger-

Table 19 • Largest Swedish electricity generators, generation between 1990 and 1997, TWh, and installed power in 1997, MW

	1990	1991	1992	1993	1994	1995	1996	1997	Installed power in 1997, MW
Vattenfall AB	75.8	73.5	75.3	74.5	72.9	74.7	71.3	73.5	16 734
Sydkraft AB	23.2	24.7	20.8	25.1	25.7	27.0	24.7	28.2	6 518
Båkab Energi[1]	*5.6*	*5.0*	*5.6*						
Gullspångs Kraft	4.3	4.2	7.9	8.1	8.2	8.9	9.8	10.5	2 577
Uddeholm Kraft	*4.1*	*4.1*							
AB Skandinaviska Elverk	*2.2*	*2.3*	*2.2*	*2.1*	*1.6*	*1.9*			
Stockholm Energi AB	7.9	7.8	7.9	7.8	9.6	10.5	10.4	9.7	2 342
Stora Kraft AB	6.4	6.4	6.3	6.3	5.5	5.8	5.3	6.1	1 469
Skellefteå Kraft	2.4	2.2	2.6	2.8	2.2	2.5	2.2	2.5	585
Graninge	2.9	2.8	3.1	3.4	2.4	2.5	1.8	2.5	561
Total	134.8	133.0	131.7	130.1	128.3	133.8	125.5	133.0	30 786
Total in Sweden	**142.2**	**142.6**	**141.5**	**141.5**	**138.6**	**143.3**	**136.4**	**144.9**	**34 044**

[1] The company was purchased by Sydkraft AB in 1997.
Note: The generation figures exclude minority shares. Contracted power is included in the company that has power available.
Source: Swedish Power Association.

many all intend to be leaders on the future northern European electricity market. This is illustrated by the way the companies take over other companies, purchase shares, form alliances and establish subsidiaries in Sweden and other countries.

Foreign ownership in Sweden ...

Figure 15 shows an outline of the ownership conditions on the Nordic electricity market. Foreign interests own 55% of Sydkraft (proportion of share capital). PreussenElektra, the Germany power utility, is now the biggest individual owner, with 18% of the share capital and 28% of the votes. Statkraft of Norway owns 17% of the share capital and 21% of the voting rights in Sydkraft, after purchasing shares during 1996 from the French Electricité de France, EdF, and parts of the shares held by Malmö, Landskrona and Oskarshamn municipalities. During 1997, Hamburgische Elektrizitätswerke, HEW, of Germany purchased Sydkraft shares corresponding to 15.7% of the capital and 3% of the votes.

In 1996, the state-owned Finnish company Imatran Voima, IVO, purchased Gullspångs Kraft shares corresponding to 51.5% of the voting rights and 44.1% of the capital, and Gullspång thus became a subsidiary of IVO. Vattenfall and Graninge also purchased shares in Gullspång, but sold these to IVO in 1997, whose ownership in Gullspång thus increased substantially. Towards the end of 1997, IVO owned 95% of the Gullspång votes and 93% of the capital. IVO then purchased further shares and, early in 1998, submitted a request to the Gullspång Board of Directors to redeem the remaining shares, and now owns 100% of the Gullspång shares.

IVO and Stockholm Energi concluded a cooperation agreement a couple of years ago. Cooperation began in 1996 by the formation of Birka Kraft AB, in which both companies have equal shares. The operations include the generation and distribution of electricity, generation of heat and steam for district heating, and contracting work. During the autumn of 1997, IVO and Stockholm Energi, together with Trondheim Energy Authority, formed the Birka Norden AB company. As from January 1998, the company offers financial portfolio management to major electricity customers. At the end of 1997, a decision was taken to initiate negotiations between Stockholm City and IVO concerning a possible merger between Stockholm Energi and Gullspång. The point of departure for the negotiations was that Stockholm City and IVO would each have a 50% holding in the new company. The negotiation work was begun after the turn of the year, but the negotiations were interrupted early in April, due to political differences between municipal councillors. Negotiations were resumed and completed in mid-May. Gullspång and Stockholm Energi merged at the end of 1998.

Foreign ownership in Graninge increased substantially during 1996, when Sydkraft and PreussenElektra purchased shares corresponding to 20% and 12.4% respectively of the voting rights. In the same year, the French EdF purchased shares in Graninge and its present holding corresponds to 30% of the votes. EdF and the descendants of the Versteegh family that founded Graninge jointly have a voting majority in Graninge. They have jointly declared that they will not vote in important matters at Board meetings without first reaching agreement among themselves.

The ownership changes on the Swedish electricity market since deregulation have resulted in further concentration of ownership. Six major power utilities now account for 90% of the electricity generated in Sweden. Purchases have also resulted in increased cross-ownership, with both Swedish and foreign companies participating.

... and Swedish ownership in neighbouring countries

As a result of the changes on the electricity markets in the Nordic countries, Swedish companies are also securing a firmer foothold on the markets of other countries. Some examples are outlined below:

Vattenfall owns shares in other Nordic power utilities and has also established subsidiaries in Finland and Norway. The company is interested in further acquisitions in the Nordic countries and in northern Europe, both in electricity generation and in network operations. During 1996, Vattenfall purchased holdings in the Norwegian company Hafslund, the Danish Nesa A/S, and also acquired the remaining shares in the Finnish Hämeen Sähkö Oy. Finnish Hämeen Sähkö Oy is the third largest Finnish electricity distribution company, with around 150 000 customers and an annual energy demand of 2.2 TWh. Vattenfall already owns Lapuan Sähkö Oy, which is a medium-sized Finnish distribution company. In conjunction with the sale of the Vattenfall holding in Gullspång Kraft to Imatran Voima Oy in June 1997, Vattenfall acquired 49% of the shares in the Finnish Pamilo Oy hydro power utility. In addition, Vattenfall concluded an agreement for rights to generation capacity in Etelä-Pohjanmaan

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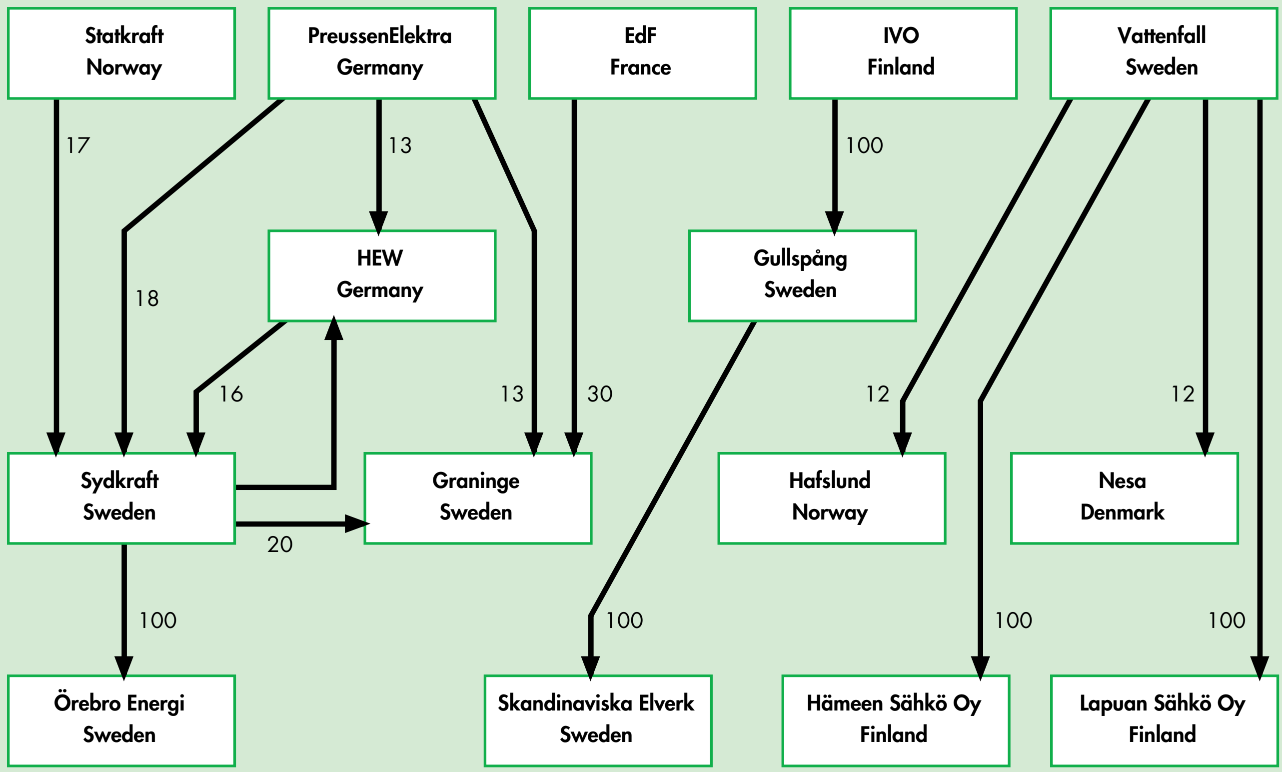
Figure 15 • Ownership situation on the Nordic electricity market 1997 and 1998



Note: The figures show the percentage capital holdings.
Source: *Elmarknaderna runt Östersjön 1997 (Electricity markets around the Baltic Sea in 1997)* R 1997:81, NUTEK and the Annual Reports of the companies.

Voima Oy, EPV. Vattenfall supplies a total of around 5 TWh of electricity annually to the Finnish Enso-Gutzeit, Outokumpu and Imatran Voima Oy companies. Vattenfall now has around 7% of the market in Finland.

Vattenfall also owns 11.5% of the shares in the Danish Nesa A/S distribution utility. Nesa distributes electricity to 490 000 customers in Denmark. Vattenfall already had extensive cooperation with Sjællandske Kraftværker, SK, in which Nesa has a 52% holding. Vattenfall and SK are planning to build the Avedöre II coal-fired combined heat and power station outside Copenhagen. Having first rejected the plans, the Danish government granted permission for the construction in March 1998. Cooperation with SK also includes the right to transmit electricity on the Kontek HVDC cable between Denmark and Germany, and the sale of generation capacity to SK. Vattenfall supplies annually a total of about 0.6 TWh to Denmark. Vattenfall now has 2.5% of the Danish electricity market.

In January 1997, Vattenfall acquired a further 8.1% of the voting rights in the Norwegian Hafslund ASA, and now owns 20% of the voting rights and 11.8% of the capital. Vattenfall supplies annually a total of about 2.6 TWh of electricity to Norway. Vattenfall now has roughly 2% of the Norwegian electricity market.

Vattenfall is expecting to use the newly established Vasa Energy GmbH & Co KG, which it owns together with Kommunalfinanz, as a vehicle for establishing itself on the German market. The company is sited in Hamburg and operates smaller combined heat and power plants in Germany. During 1996, Vattenfall also entered the Czech market by purchasing 7.8% of the shares in the Czech electricity distribution company Vycjodoceska Energetika a s. The company sells around 6 TWh of electricity to about 600 000 customers.

Graninge established itself in Finland by concluding two business deals during 1997, i.e. the purchase from IVO of a 60-year right to the Kemijkoi Oy hydro power generation capacity on Kemi River corresponding to 45 MW, and the purchase of 25.7% of the shares in Kainuun Sähkö Oy. Kainuun Sähkö Oy is a distribution utility in eastern Finland, with operations in electricity distribution, district heating and some power generation. Graninge also acquired a holding in the Norwegian Sognekraft A/S, although this was sold after the turn of the year. Graninge has also concluded an agreement with IVO, giving it the right to use part of the power generation capacity allocated to IVO by virtue of its part-ownership of the Finnish company Kemijoki Oy. The agreement is part of the settlement through which IVO takes over the shares owned by Graninge in Gullspång Kraft.

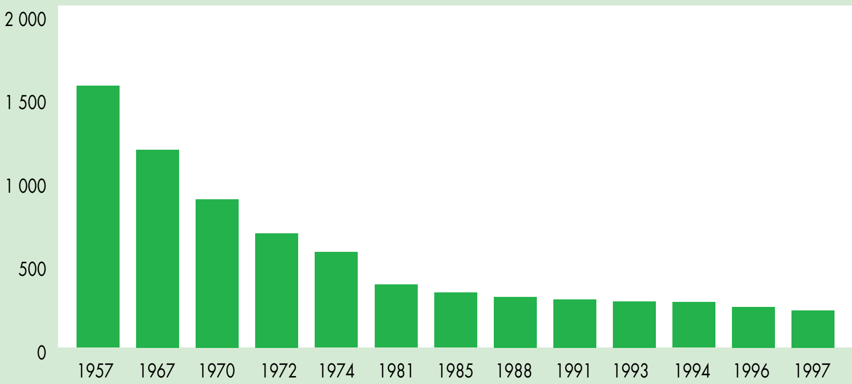
During 1997, Sydkraft acquired 21.8% of the shares, corresponding to 20.1% of the voting rights, in the German Hamburgische Elektrizitätswerke. The company's electricity sales amount to about 11 TWh to 900 000 customers. In addition, Sydkraft has acquired 5% of the capital in the German HEVAG distribution company which supplies 2.5 TWh of electricity annually to 400 000 customers.

Figure 15 shows the ownership situation early in 1998, but does not include the merger of Gullspångs Kraft and Stockholm Energi concluded at the end of 1998. The new company, which is known as Birka Energi, is the largest electricity utility in Sweden in terms of the number of customers, and IVO has a 50% holding in the company. ■

Electricity distribution has undergone vast restructuring since the 1950s. The number of electricity distribution utilities dropped from 1570 to around 220 between 1957 and 1997. This is a development that the State has endeavoured to accelerate by the work pursued in conjunction with the granting of concessions and, in the past, through financial support from the State.

The new Electricity Act does not allow a given company to pursue both network operations and trading in electricity. The original municipal electricity utilities were therefore obliged to separate their operations into one company for electricity sales and another for network operations. In October 1997, 223 network utilities were registered. This figure is expected to drop further.

Figure 16 • Total number of electricity distribution utilities between 1957 and 1994, and network companies in 1996 and 1997



Source: Compilation of information from *Detaljdistributörer av elkraft 1994 (Reetail distributors of electric power in 1994)*, and *Detaljdistributörer av elkraft, elnätföretag, 1996 (Retail distributors of electric power, electric network utilities, in 1996)*, both from Association of Swedish Electric Utilities.

Network utilities

A network utility owns the power line network within a geographical area and is responsible for the distribution of electricity to the end customers. In conjunction with the electricity market reform, it became clear that the yield on the capital investment in the network utilities was generally low. The current restructuring tends towards larger and fewer network companies by mergers of smaller local network utilities and by takeovers. Long-term developments may lead to lower costs and better profitability of the network operations, which may be of benefit to the end consumers.

The National Energy Administration, one of the tasks of which is to supervise the pricing in the network operations, expects to contribute to restructuring in this field by the demands made on efficiency. The National Energy Administration must ensure that electricity users do not pay a price which is higher than necessary for the network services, and that the network tariffs, the metering system and the settlement system are designed so that competition in trading in electricity is promoted.

Electricity trading companies

Electricity trading companies buy electricity from a number of different power generators, including Norwegian and Finnish companies, and also on the Swedish-Norwegian electricity exchange. Most of these companies are newly formed, having broken away from the original municipal electricity utilities. The number of electricity trading companies is lower than the number of network utilities. Some of the original municipal electricity utilities have sold or formed joint electricity trading companies with other companies, while still maintaining the network operations. Several of the newly formed joint companies are owned by municipal energy utilities. In some cases, industrial companies, oil companies and trade organizations have purchased holdings in the electricity trading companies.

Other players have also begun selling electricity, such as the oil companies OK, Statoil and Shell. These companies have a competitive edge, since they can market and sell electricity at filling stations, thus gaining access to a large number of prospective customers. Restructuring in the electricity trading sector is much more extensive than on the network side, since electricity trade is much more open to competition. This enables new companies to gain a foothold on the market and force existing companies to rationalize their operations.

Take-overs of electricity trading and distribution companies

Growing numbers of municipal and smaller energy utilities are being taken over by other companies. Municipalities have several rea-

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Table 20 • Number of electricity distribution utilities between 1957 and 1994, and network utilities in 1996 and 1997

Number of subscriptions	1957	1967	1970	1972	1974	1981	1985	1988	1991	1993	1994	1996[1]	1997[2]
50–99	200	87	54	34	24	8	3	1	1	-	-	-	-
100–199	285	153	86	63	35	12	7	6	4	3	3	4	2
200–499	500	323	181	115	82	28	22	14	10	7	6	3	1
500–999	251	195	164	104	81	31	21	14	11	11	12	6	4
1 000–1 999	154	170	121	89	71	40	23	22	24	20	19	15	16
2 000–4 999	82	126	136	119	113	84	70	64	53	52	51	47	46
5 000–9 999	51	64	70	77	75	65	63	65	62	56	51	45	40
10 000–19 999					50	55	63	58	63	65	66	63	54
20 000–49 999	46	64	70	75	32	43	43	44	44	43	42	40	39
50 000-		5	8	9	10	11	14	16	17	20	23	21	21
Total	**1 569**	**1 187**	**890**	**685**	**573**	**377**	**329**	**304**	**289**	**277**	**273**	**244**	**223**

[1] Relates to conditions in December 1996.

[2] Relates to conditions in October 1997.

Source: *Detaljdistributörer av elkraft (Retail distributors of electric power)* for the years 1991 - 1994, Association of Swedish Electric Utilities, and *Detaljdistributörer av elkraft, elnätföretag, 1996 (Retail distributors of electric power, electric network utilities, in 1996)*, Association of Swedish Electric Utilities, *Elnätföretag 1997 (Electricity network companies in 1997)*, Swedish electricity Distributors.

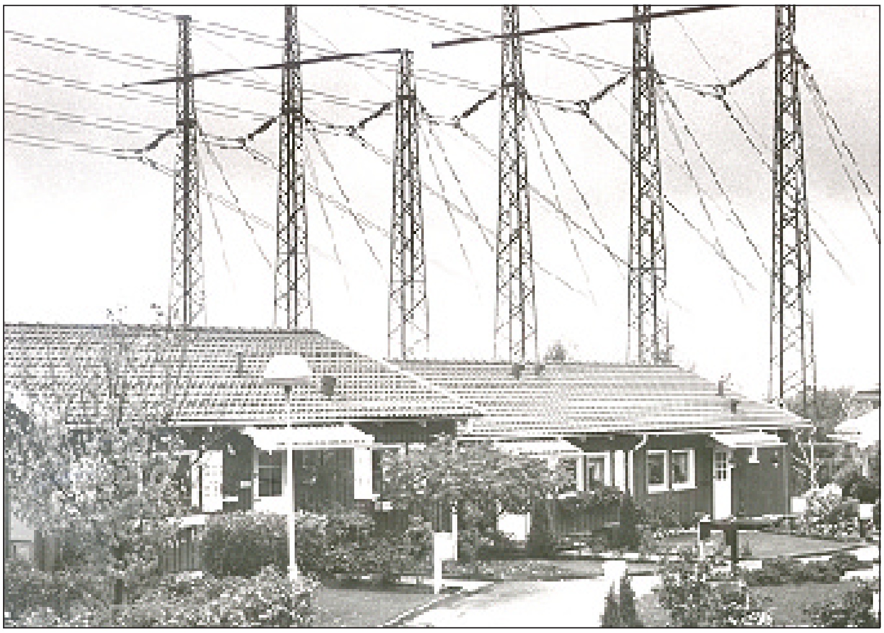
Table 21 • Jointly owned electricity trading companies in 1998

Company	Interested parties
7 H Kraft	Ulricehamn, Sandhult-Sandared, Östra Kind
Agrokraft	LRF, Svenska Lantmännen
Billinge Energi	Skövde, Skara, Tidaholm,
Enskar Kraft AB	Mariestad, Töreboda
Hydro Energi Syd AB	Norsk Hydro and also the Bromölla, Olofström and Ronneby municipalities
Brista Kraft AB	Sigtuna Energi and Väsby Energi
Brukskraft	Kristinehamn, Degerfors, Filipstad, Skana-Björneborg
Dala Kraft	Ryssa, Leksand-Rättvik, Malung, Gagnef, Enviken, Smedjebacken, Säter
Energisamverkan i Skåne AB	Ringsjö, Skånska Energi, Lomma
Fyrstad Kraft	Lysekil, Trollhättan, Uddevalla
Fyrfasen Energi AB	Bergs Tingslag Elektriska AB, Härjeåns Kraft AB, Ånge Elverk AB
Gestrikekraft	Gävle, Sandviken, Hofors, Vattenfall
HöglandsEnergi AB	Nässjö Energi AB, Sävsjö
Kinnekulle	Götene, Mariestad, Töreboda, Karlskoga
Kraftaktörerna	NVSH-Energi, Södra Hallands Kraft, Ängelholm, Ljungby, Bjäre Kraft
Kraftringen	Boo, Östra Roslags, Nynäshamn, Vallentuna
Lund Eastern Energi AB	Lunds Energi, Eastern Group
MBE Handel AB	Sala-Heby, Hallstahammar, Lindesberg.
Runn Kraft AB	Borlänge Energi Försäljning AB, Stora Kraft AB
Småländsk Energiförsäljning AB	Nybro, Kalmar, Emmaboda
Sydost Energi	Affärsverken i Karlskrona, Karlshamn Energi, Sölvesborg Energi
TelgeKraft AB	Telge Energi AB, Astra, Ericsson, Scania
Västringen	Härryda, Kungälv, Ale
Öresundskraft	Hälsingborg, Höganäs
Östkraft AB	Tekniska Verken i Linköping AB, Mjölby-Svartådalen Energiverk AB

sons for selling these operations. Many municipal energy utilities are too small to stand alone on the new electricity market, trade on the electricity exchange and conclude favourable agreements with electricity suppliers. Moreover, many municipalities consider that operating on the competitive market is not a municipal task and that their influence on the electricity tariffs will disappear, since users can purchase electricity from other companies. Another reason for selling operations is to strengthen strained finances, which is one of the explanations for the network operations in the municipalities also being sold off.

A few examples of the acquisitions that have taken place during 1997 and 1998 are given below:

- In addition to purchasing Örebro Energi, Sydkraft has taken over the electricity trading operations of Ystad Energi, Markaryds Elverk and Markaryds Energi AB, Landskrona Elförsäljning, Upvidinge Eldistribution and Hässleholm Energi, with both network and electricity trading operations. In addition, the Sydkraft subsidiary BÅKAB took over the remaining part of the share capital in the Norrlands Energi electricity trading company.
- Vattenfall has purchased the Forskraft i Åtvidaberg energy utility, Nacka Energi which is an electricity trading company, Flens Energinät AB, and 40% of Gestrike Kraft. At the 1998/99 turn of the year, Vattenfall also took over Säffle Elverk AB and Säffle Energi AB.
- Graninge has purchased Enköping Elnät AB, together with the subsidiary Enköping Elförsäljning AB, as well as the Kramfors Energi AB electricity trading company, and Sollefteå Energi with subsidiaries.
- Gullspång purchased Ljusnarsberg Energi AB and took over the remaining block of the shares in Tiveds Energi, thus increasing its ownership from 40 to 100 percent. In addition, the company has acquired 49 percent of Katrineholm Energi.
- Stockholm Energi took over Täby Energi which has both network and electricity trading operations. ■



In 1995, Sweden was the world's fourth highest per capita user of electricity, after Norway, Iceland and Canada. The per capita electricity consumption in the United States was around 20% lower than in Sweden. In the European industrialized countries, such as Germany, France and Great Britain, the consumption of electricity per inhabitant was around half that in Sweden. The average for the EU member countries was just over 60% below the Swedish electricity consumption.

Between 1990 and 1995, total net electricity consumption in EU member countries increased by around 8% from 1823 to 1972 TWh. During the same period, the net consumption in Sweden rose by almost 2%. In Germany, the electricity consumption dropped by just under 1%.

A common factor in countries with high per capita electricity consumption is that they have had good access to inexpensive hydro power. Moreover, due to the relatively cold climate in these countries, electricity consumption for space heating is high.

Other natural resources in Sweden, such as forest and ore, contribute towards the specialization of industry in energy-intensive products. If the electricity-intensive industry in Sweden is disregarded, i.e. if the electricity consumption in the electricity-intensive industries is assumed to be replaced by the average for industry, the per capita electricity consumption in Sweden would be reduced by 15%. Canada, Norway and Finland also have a high share of energy-intensive industry. All of these countries also participate in the international division of labour by exporting a large proportion of electricity-intensive products, which gives an additional explanation to the relatively high per capita figures.

Sweden is one of the world's countries with a high proportion of hydro and nuclear power in the generation system. Only Switzerland, Norway and Canada have higher proportions of hydro power. France and Belgium have higher proportions of nuclear power than Sweden. Seen from an international perspective, Sweden has a small proportion of electricity generation based on fossil fuels, the

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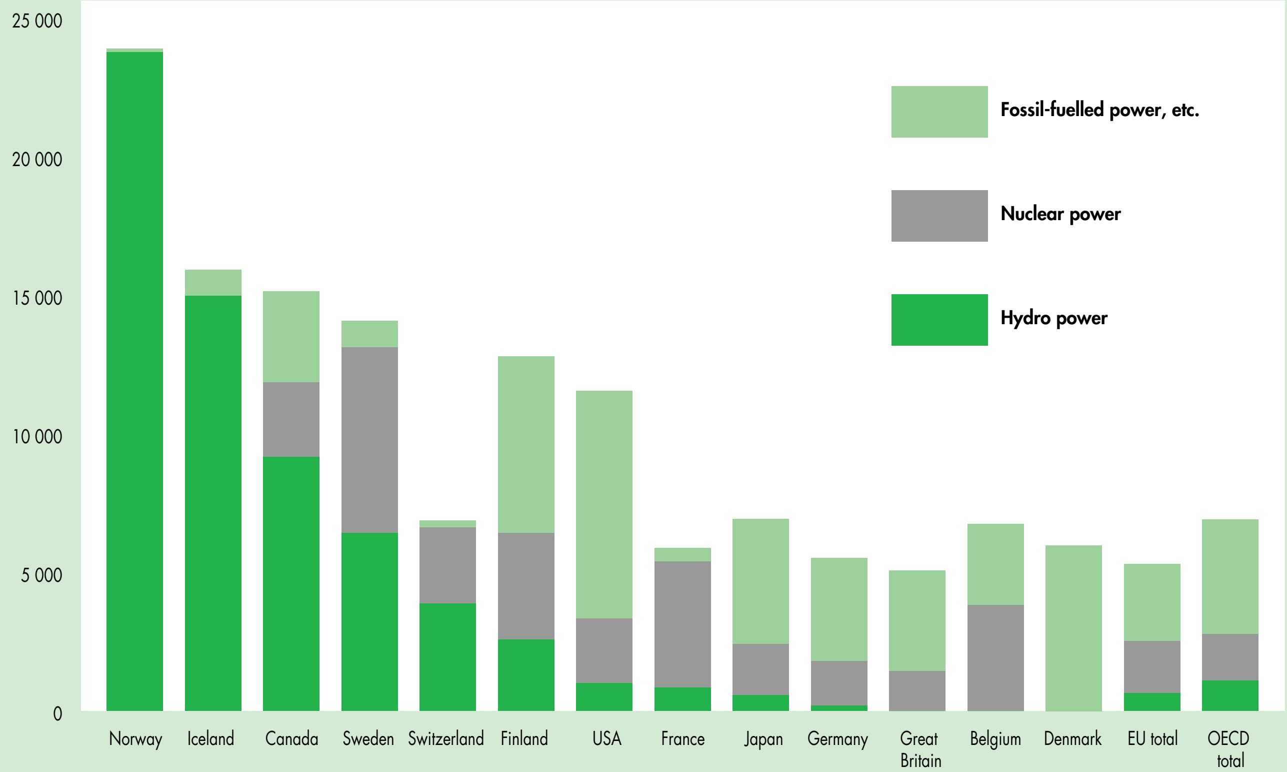
Table 22 • Electrical energy generation 1995, TWh, and net electricity consumption, MWh per inhabitant

	Hydro power	Nuclear power	Fossil-fuelled power, etc.	Total generation	Electricity cons. per inhabitant, MWh
USA	314.2	713.8	2530.4	3 558.4	11.6
Japan	82.2	261.8	636.9	980.9	6.9
Canada	333.8	97.8	119.8	551.4	15.2
Germany	19.8	154.1	358.7	532.6	5.5
France	71.3	377.2	40.8	489.3	5.9
Great Britain	5.3	89.0	238.7	332.9	5.1
Sweden	67.0	69.9	10.1	147.0	14.1
Norway	121.3	0.0	0.7	122.0	23.9
Belgium	0.3	41.4	31.9	73.6	6.8
Finland	12.9	19.2	31.8	63.9	12.8
Switzerland	35.2	24.9	2.2	62.3	6.9
Denmark	0.0	0.0	36.8	36.8	6.0
Iceland	4.7	0.0	0.3	5.0	15.9
EU total	**287.3**	**810.2**	**1 210.1**	**2 307.6**	**5.3**
OECD total	**1 287.1**	**1 972.5**	**4 871.0**	**8 130.6**	**6.9**

Source: Compilation of information from OECD/IEA.

Figure 17 • Net electricity consumption per inhabitant in 1995, with relative distribution per type of power, kWh



Source: Compilation of information from OECD/IEA.

Table 23 • Electricity prices for domestic and industrial customers, including taxes, on 1 January 1998, öre per kWh

	Small industrial plant [1]	Medium-sized industrial plant [2]	Large industrial plant [3]	Domestic customer 3 500 kWh	Domestic customer 20 000 kWh
Australia, Sydney	56	29	21	62	30
Belgium	77	60	37	147	74
Denmark	52	50	46	157	132
Estonia	52	34	23	35	25
Finland	43	38	28	77	46
France	61	52	37	127	87
Greece	55	51	35	81	55
Ireland[4]	70	54	42	96	50
Italy	96	77	51	195	-
Japan, Tokyo	105	85	42	155	68
Canada, Montreal	51	34	22	55	38
Lithuania	35	27	23	35	26
Luxembourg	75	49	37	114	64
The Netherlands, Rotterdam	66	52	40	115	73
Norway	39	28	21	107	70
Poland	40	34	23	53	35
Portugal	70	62	42	121	76
Spain	63	53	44	117	66
Great Britain[5]	80	69	61	105	53
Sweden	**42**	**33**	**27**	**91**	**74**
Germany[6]	84	69	47	158	75
Hungary	52	44	38	68	42

Note: The prices specified for industry are exclusive of VAT.

Source: Compilation of information from Unipede, Prices of Electricity as at 1 January 1998, SSB/Norway, Eurostat and the Swedish National Energy Administration.

[1] 1.25 GWh per year, 0.5 MW, 2500 hours.
[2] 10 GWh per year, 2.5 MW, 4000 hours.
[3] 70 GWh per year, 10 MW, 7000 hours
[4] The household prices in Ireland are for urban areas.
[5] Great Britain: Industrial prices are for the industrial region and the prices to households relate to London.
[6] Germany: The industrial prices are for the industrial region and the prices to households relate to Hamburg.

actual figure in 1995 being 7%. In EU member countries, more than half the electricity generation is based on fossil fuels and only 12% on hydro power.

Total electricity generated in EU countries in 1995 was around two thirds of that generated in the USA. The electricity generated in the USA is just under half of that generated in OECD countries. Sweden accounts for slightly less than 2% of electricity generated in OECD countries and 6% of that in the EU. Total electricity generated in EU countries increased by almost 8% between 1990 and 1995. Electricity generation in Sweden increased by just over 1% during the corresponding period.

Electricity prices

Electricity prices vary for different user categories, i.e. households and industry. However, the differences may vary from country to country.

Increased competition on the electricity markets

The electricity industry is currently undergoing extensive changes in many parts of the world. This is due to new market conditions, new technology and growing environmental demands. Northern Europe and, above all, the Nordic countries are far ahead in this development, due to deregulation of the electricity markets in Finland, Norway and Sweden.

On 19 December 1996, the EU issued a directive "on collective rules for the common market for electricity", known as the Electricity Market Directive. The directive came into force on 1 January 1997, with a two-year transitional period, during which the national legislation of the member countries was to be reconciled to the directive. The directive specifies that the market for electricity shall gradually be opened to competition in terms of both trading and establishment of generation capacity on the EU electricity markets. The electricity markets will be opened gradually and at different rates in the various countries, and it may therefore take some time before the common market for electricity is fully established. The Electricity Market Directive came into force on 19 February 1999. Most countries find it difficult to live up to the directives.

Countries outside the EU are also planning to open their electricity markets. Poland, the Czech Republic and Hungary have decisions or far-reaching plans for deregulation of the electricity markets. Similar developments are also discernible among countries in South America, South-East Asia and Oceania. A decision was taken in 1997 in the State of California concerning far-reaching deregulation, which will probably mark the beginning of a deregulation process in the United States.

Deregulation of electricity markets means a transition from national monopolies with central planning to markets that are open to competition. Electricity will become an energy raw material that can be traded and delivered across national borders. Power utilities are being restructured towards steadily growing and more integrated energy companies with operations in several countries. Strategic investments are being made by the large power utilities in the northern European countries, with the aim of increasing their market shares on a future common electricity market. Mergers, take-overs and alliances are examples of measures being taken by the companies, often across national borders.

In addition to increased competition between companies, markets and countries, deregulation of electricity markets also contributes towards countries and regions being linked together by new commercial ties. This is illustrated by the electricity markets in the Nordic countries. Trade in electricity on cable links between the Nordic countries is increasing, and so is trade between the Nordic countries and the Continent.

For electricity markets to perform well, the various markets must have collective rules and conditions. Harmonization of energy and environmental taxes is an example of a condition which is important from the perspective of the Nordic countries. ■

Publications in English

Energy in Sweden 1998
ET 26:1998

The publication is annual and this year's issue for 1998 is the fifteenth in succession. This publication gives generalized and easily understandable information on the composition and development of the Swedish energy system. "Energy in Sweden" consists of an abundantly illustrated text version and a tabular appendix entitled "Energy in Sweden, facts and figures 1998". The tabular appendix contains numerical information for the figures in the text version, which are comprehensive time series from 1970 onwards. These include series of consumption, distributed onto sectors and onto energy carriers, and also prices and taxes on different energy carriers and to different users.

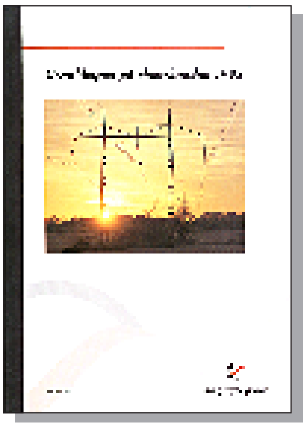
Climate report 1997
ER 2:1998

The report serves as a basis for Sweden's second national report on climatic changes, Ds1997:26.

The analysis is focused on the contribution of the energy system to the Swedish carbon dioxide emissions. The report contains energy forecasts for the years 2000, 2005 and 2010, and thus covers the initial stages of nuclear decommissioning. Since the Riksdag had not yet taken a decision when the report was written, it is assumed that an average reactor will be decommissioned in the year 2000.

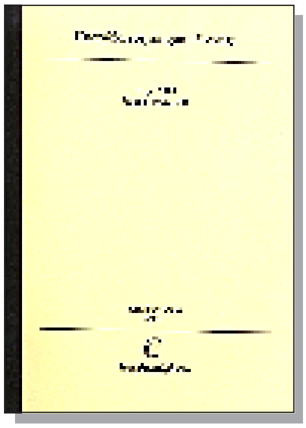
Publications in Swedish

Utvecklingen på elmarknaden 1998 (Development on the electricity market in 1998)
ER 29:1998



This is the report of the Swedish National Energy Administration on its assignment to follow annually the developments on the electricity market. The report is the third in succession and gives particulars of different aspects of the developments on the competitive market since deregulation on 1 January 1996. The report follows matters such as price and structural changes.

Energiförsörjningen i Sverige, kortsiktsprognos (Energy supply in Sweden, short-term forecast)



Issued twice a year in March and September, and prepared on the instruction of the Ministry of Finance and the National Institute of Economic Research. The latest version was issued on 1 March 1999 and includes a report on the energy supply situation for 1997 and 1998, and also forecasts for the years 1999 - 2000. This is the third energy forecast since the decision was taken to begin nuclear power decommissioning in accordance with the Riksdag decision. The conclusions are that the net imports will increase as a consequence of the first reactor in Barsebäck being shut down.

Energi och miljö inom EU (Energy and the environment in the EU)
ET 45:1999

Membership of the EU and the growing international cooperation on climate make Sweden increasingly influenced by EU legislation in the fields of the environment and energy. However, the EU does not have the legal right in any of its treaties to pursue energy policy. In spite of this, member countries have succeeded in agreeing on a succession of collective decisions in various energy and environmental matters. The EU is one of the world's biggest energy-using regions. But the various countries differ widely in their industrial development, industrial structure, standards of living, climates, transport distances and other factors that govern the energy systems and their influence on the environment.

This publication gives an easily understandable overview of the decision processes and the energy and environmental policies of the EU, and of the specific conditions characterizing the energy systems of the member countries. The publication is aimed at decision-makers, journalists and members of the general public who are interested in energy.

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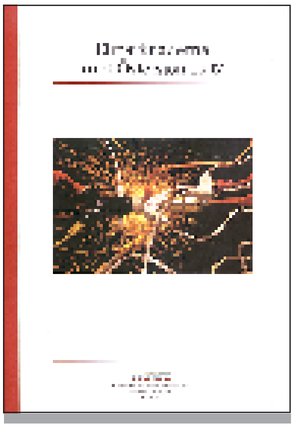
ORDERS

All publications can be ordered from the Publication Service of the Swedish National Energy Administration, P.O. Box 310, SE-631 04 Eskilstuna, Sweden.

Fax: +46 16 544 22 59. e-mail: forlaget@stem.se

Elmarknaden runt Östersjön (Electricity market around the Baltic Sea)

R 1997:81



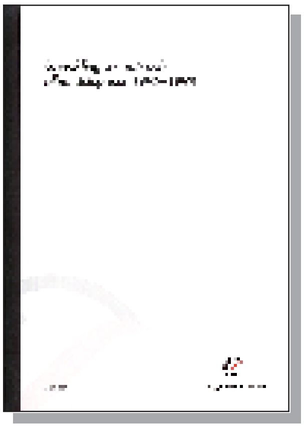
The objective of the report is to follow the changes that are taking place in the region as regards the organization and structure of the electricity market. The countries discussed are the Nordic countries (excluding Iceland), the Baltic states, Russia, Poland and Germany.

The electricity generated in the Baltic Sea region amounts to around 1100 TWh annually, half of which is from conventional thermal power, mainly coal-based, and a quarter each by hydro power and nuclear power. The composition of the generation capacity and the choice of fuel vary from country to country, which is discussed in the report.

The report also deals with the structure of electricity utilization and forecasts for future electricity consumption of the countries in the region. It also includes particulars of electricity prices and taxes, environmental problems and environmental requirements, electricity trade with foreign countries, and the national network of each country. A comparison is also made of the various economic key factors in the biggest energy companies that operate in the region. Based on the annual reports of the companies, a comparison is made of matters such as turnover, different earning capacity yardsticks, equity/assets ratios, and operating margins.

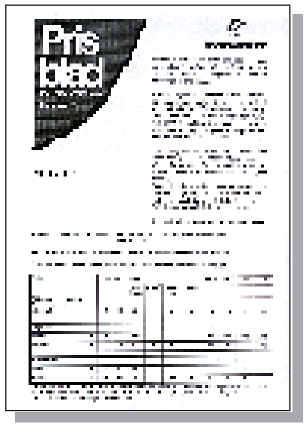
Utveckling av nät och elhandelspriser 1996 - 1998 (Development of network and electricity trading prices between 1996 and 1998)

ER 6:1998



The Swedish National Energy Administration is entrusted with the task of assessing whether the tariff levels of the companies are reasonable, and the Administration can instruct the companies to lower their tariffs if these are considered to be unreasonably high. The Network Department gathers tariff and price information from all network utilities in the country and the electricity trading companies that have delivery concessions. This information is published in this report. The most important conclusions are that the difference between the highest and lowest network charges has dropped, but the scatter between the companies is still wide.

Prisblad för biobränslen, torv mm (Price list for biofuels, peat, etc.)



Issued four times a year. The price list comprises the prices of processed and unprocessed wood fuels and peat, and also heat from district heating systems for different categories of users.

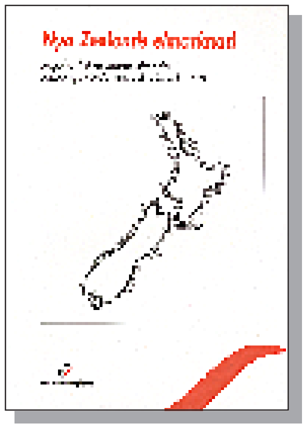
Undantag från krav på nätkoncession (Exceptions from network concession requirements)

ER 31:1998

Exceptions from the obligation to apply for a network concession have remained unchanged over a substantial period of time. The Government entrusted the Swedish National Energy Administration with the task of reviewing the exceptions and suggesting amendments wherever needed. The work done under this assignment is presented in this report.

Nya Zeelands elmarknad (New Zealand's electricity market)

ET 43:1999



The report describes the sequence of events, reasons and consequences of the serious blackout that occurred in Auckland early in 1998.

Up to the serious economic crisis during the 1970s and 1980s, New Zealand was one of the world's most ambitious welfare states. In addition, it was one of the most closely regulated among the OECD countries. The economic crisis led to several of the western-world's most radical deregulations in commerce and industry. In electricity distribution, the regulatory system was reduced to what can be described as almost self-regulation, whereby the players on the market took over responsibility for the performance of the market.

The serious blackout in the economic centre of the country - the city of Auckland, with its population of more than one million - in 1998 had such serious consequences that a review of the regulatory system was initiated. Proposals have been submitted for a review of the electricity legislation.

ORDERS

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EL-EX/Nord Pool in Finland
Phone: +358-9-6840 480
http://www.nordpool.no

The *Electricity Market Authority* in Finland is a Government department responsible to the Finnish Ministry of Trade and Industry. The main task of the Electricity Market Authority is to ensure that the Electricity Market Act is observed and to promote the operations on the electricity market which is now based on competition.
Phone: +358 9 622 0360. http://smk.inet.fi

The Danish *Energy Agency* is engaged in matters related to the generation, distribution and use of energy, and is entrusted with the task of ensuring, on behalf of the Government, that energy development in Denmark takes place effectively from socio-economic environmental and safety aspects.
Phone: +45 33 92 67 00. http://www.ens.dk

The *Swedish Competition Authority* is a central authority for competition matters and its task is to promote effective competition in private and public operations, to the benefit of the consumers.
Phone: +46 8 700 1600. http://www.kkv.se

The *National Environmental Protection Agency* works towards reducing emissions in Sweden and other countries, and improving the environment by encouraging governmental authorities, sector authorities, regional and local authorities, companies and the general public to take decisions and adopt measures that will lead to the targets set up.
Phone: +46 8 698 10 00
http://www.environ.se

Nordel is an organization promoting Nordic electricity cooperation. The organization, which was founded in 1963, is a consultative and advisory body, and the primary objective is to create and develop the condition for an effective Nordic electricity market. Nordel serves as a cooperative body for those responsible for the system and serves as a forum for the players on the market and those responsible for the system in the Nordic countries.
Phone: +47 22 52 70 00.
http://www.nordel.org

NordPool is the Nordic electricity exchange and organizes markets for spot trading and price assurance.
Phone: +46 8 555 166 00
http://www.nordpool.no

Swedish Ministry of Industry, Employment and Communications
Phone: +46 8 405 10 00
http://www.naring.regeringen.se

The *Norwegian Water Resources and Energy Directorate, NVE*, is subordinate to the Norwegian Oil and Energy Department and is responsible for managing the Norwegian water and energy resources.
Phone: +47 22 959 595. http://www.nve.no

The *Swedish Nuclear Power Inspectorate, SKI*, plays a supervisory role in ensuring that nuclear engineering operations are pursued in a safe manner. Companies with permits to pursue nuclear engineering operations also bear full responsibility for safety in the plants and for safe handling and terminal storage of spent nuclear fuel.
Phone: +46 8 698 84 00. http://www.ski.se

Statistics Sweden is responsible for public statistics, together with the relevant authorities.
Phone: +46 8 783 40 00. http://www.scb.se

The *Swedish District Heating Association* is a trade organization for district heating companies, a cooperative body for Swedish heating plants and other companies that are interested in heat distribution, especially if combined with power generation.
Phone: +46 8 677 25 50. http://www.fvf.se

Svenska Kraftnät is entrusted with the task of managing, operating and developing in a businesslike manner a cost-effective, reliable and environmentally appropriate power transmission system, selling transmission capacity and otherwise pursuing operations linked to the power transmission system.
Phone: +46 8 739 78 00. http://www.svk.se

The *Swedish Power Association* is a trade organization for the power generation utilities.
Phone: +46 8 677 25 60. http://www.kvf.se

Swedish Electricity Distributors is a trade organization for the country's network and local electricity trading companies, and has a wide range of services and products that support the operations and development of member companies.
Phone: +46 8 677 25 40. http://www.svel.se

FACTS

The standard international unit for measuring energy is the joule (J). However, the watt hour (Wh) is often used in Sweden. 1 joule is equivalent to 1 watt second, and 1 watt hour is consequently 3600 J. The tonne oil equivalent (toe) unit is often used in international comparisons. 1 toe corresponds to the heat liberated in the combustion of 1 tonne of oil, which amounts to 11.6 million Wh. The joule, watt hour and even the tonne oil equivalent are impractically small units when large quantities of energy are considered. Multiples of the basic unit, such as thousands or millions of watt hours, are used instead, and these are abbreviated as shown below.

Multiple name	Symbol	Numerical value
kilo	k	10^3= 1 000
mega	M	10^6= 1 000 000
giga	G	10^9= 1 000 000 000
tera	T	10^{12}= 1 000 000 000 000
peta	P	10^{15}= 1 000 000 000 000 000

Power is measured in:

1 000 watt (W) = 1 kilowatt (kW)
1 000 kW = 1 megawatt (MW)
1 000 000 kW = 1 gigawatt (GW)

Energy is obtained by multiplying time by power. Energy is measured in:

1 000 kilowatt hours = 1 megawatt hour (MWh)
1 000 000 kWh = 1 gigawatt hour (GWh)
1 000 000 000 kWh = 1 terawatt hour (TWh)

In practical use

1 kWh is roughly the electricity used by an electric cooker plate in one hour.
1 MWh is roughly the electricity used by a household over a period of three months.
1 GWh is roughly the electricity used in one year by 50 electrically heated single-family dwellings of normal size.
1 TWh is roughly the electricity used by the whole of Sweden over a period of three days.

Currency	1 öre (1/100 SEK)	1 krona (SEK)	100 SEK
European Union (XEU)	0.001142 XEU	0.1142 XEU	11.42 XEU
United States (USD)	0.001230 USD	0.1230 USD	12.30 USD
Japan (JPY)	0.1565 JPY	15.65 JPY	1565 JPY

Currency on 30 January 1998. Source: Riksbanken, Swedish Central Bank.

SWEDISH ELECTRICITY MARKET 1998

SWEDISH ELECTRICITY MARKET is published in Swedish and English by the Swedish National Energy Administration and can be ordered by phone from the Energy Administration.

Factual information is available from the Policy Analysis Department. General information: Becky Petsala. Electricity market: Claes Aronsson. Electricity utilization: Niklas Johansson, Åsa Leander, Magnus Thorstensson, and Agneta Tisell. Power generation systems and production costs: Stefan Goldkuhl. Nuclear power: Magnus Thorstensson. Environmental impact: Claes Aronsson. Electricity prices and the international perspective: Claes Aronsson and Agnes von Gersdorff. Taxes: Agnes von Gersdorff.

The Project Leader up to 31 January 1999 was Camilla Jönsson. The project was subsequently led by Claes Aronsson, on e-mail address claes.aronsson@stem.se, and Agnes von Gersdorff, on e-mail address agnes.von.gersdorff@stem.se.

The phone number of the Swedish National Energy Administration is +46 16 544 20 00. Further information on the Swedish National Energy Administration and its publications can be obtained on the Internet on www.stem.se.

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Swedish National Energy Administration

The Swedish National Energy Administration was established 1 January 1998 and is Sweden's national authority on issues regarding the supply and use of energy.

The Administration's main task is to implement the energy policy programme approved by the Riksdag in the spring of 1997. The aim of the programme is to establish an ecologically as well as economically sustainable energy system.

We work to promote a safe, efficient and environmentally sustainable supply and use of energy. We do so by supporting research on renewable energy sources and technology procurement of energy-efficient products and by providing investment support for the development of renewable energy.

The Administration also serves a supervising function as monitoring authority of the recently deregulated electricity market. The Policy Analysis Department provides analyses of the linkages between energy, the environment and economic growth.

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